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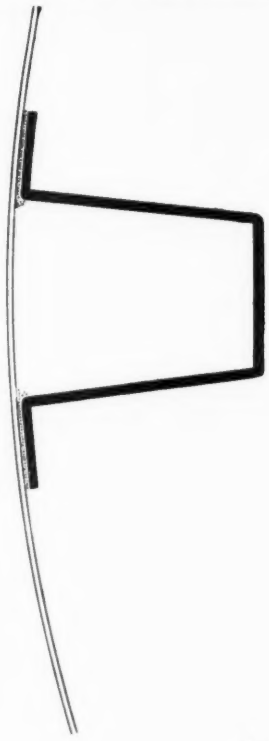

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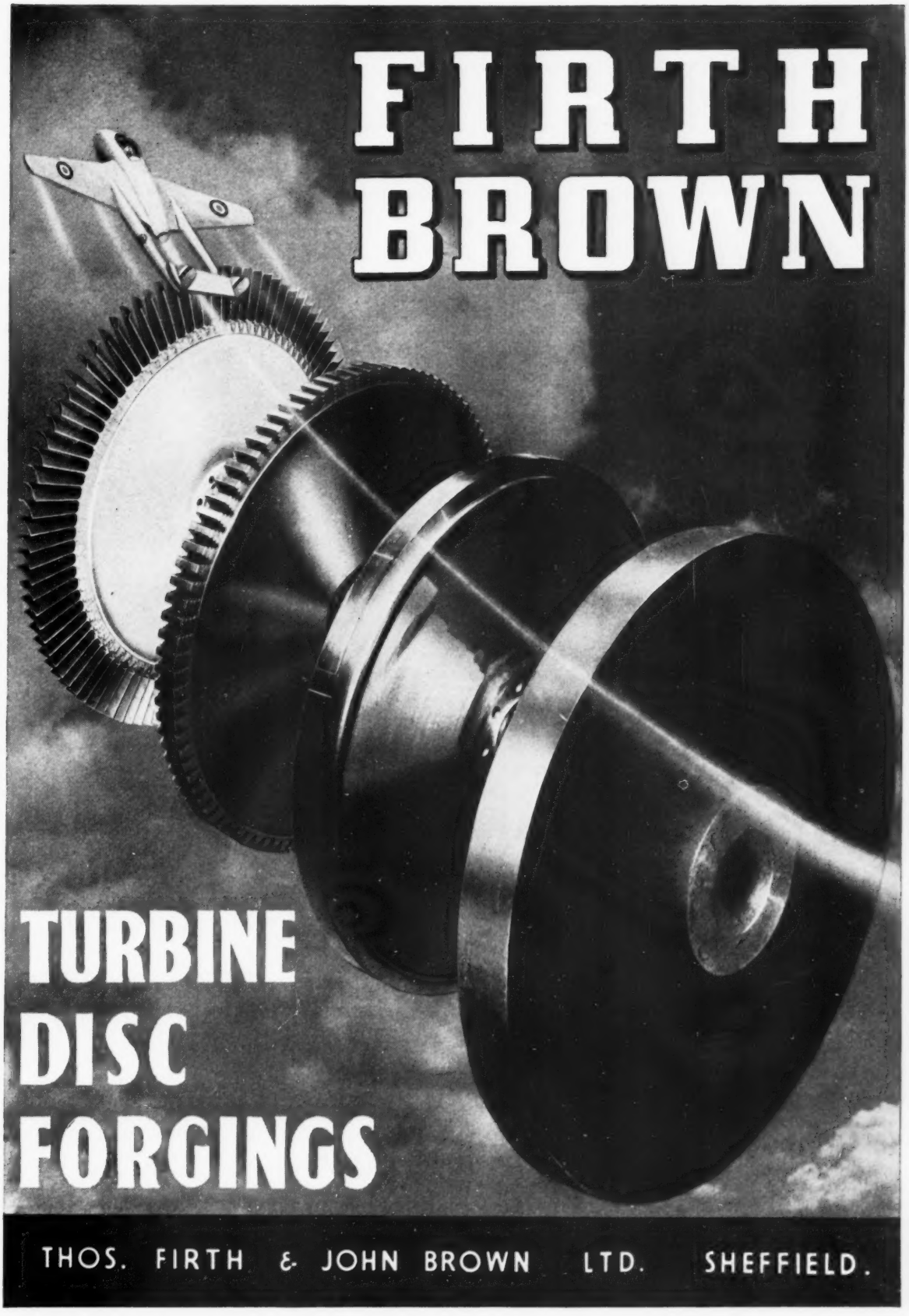
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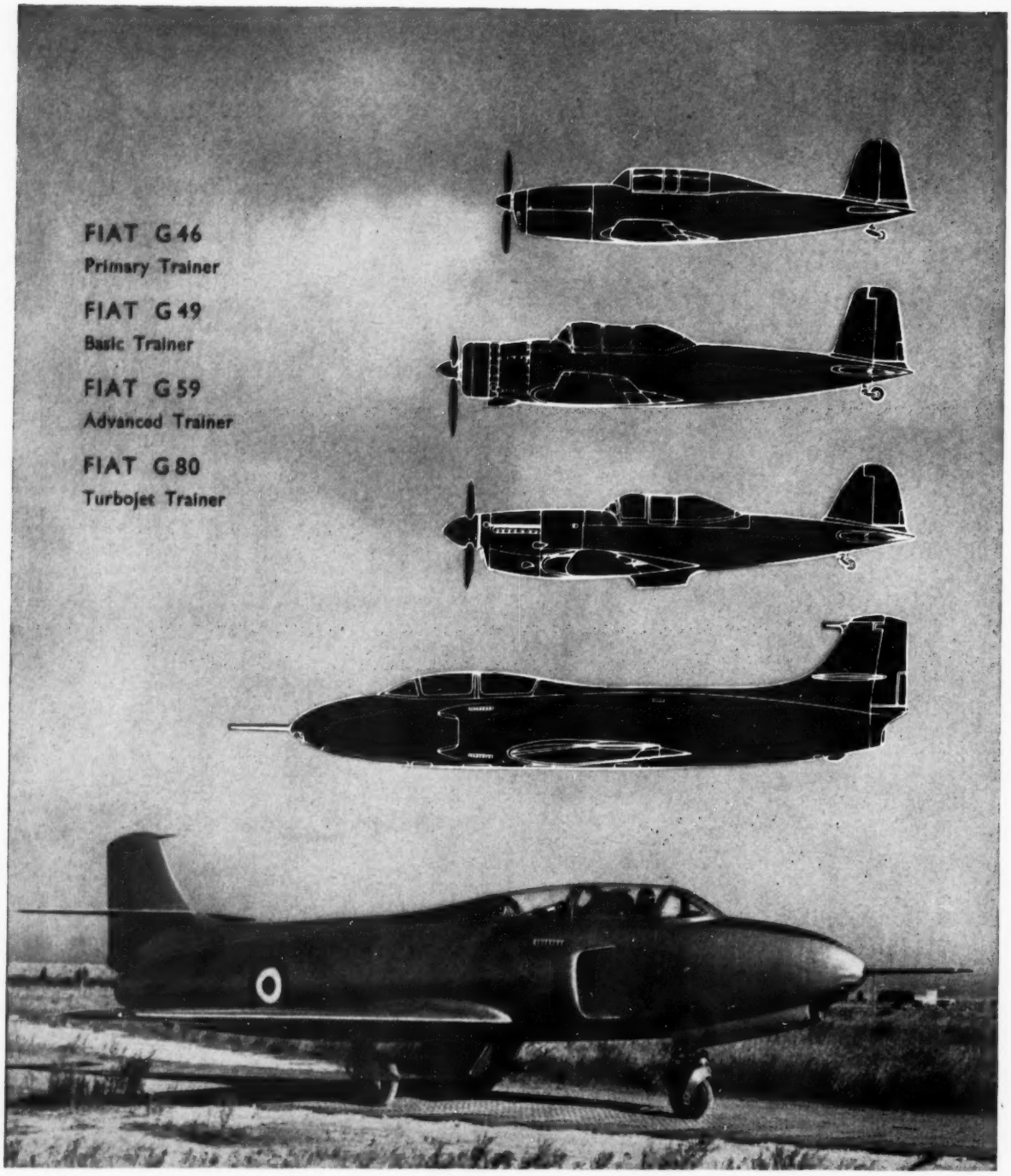

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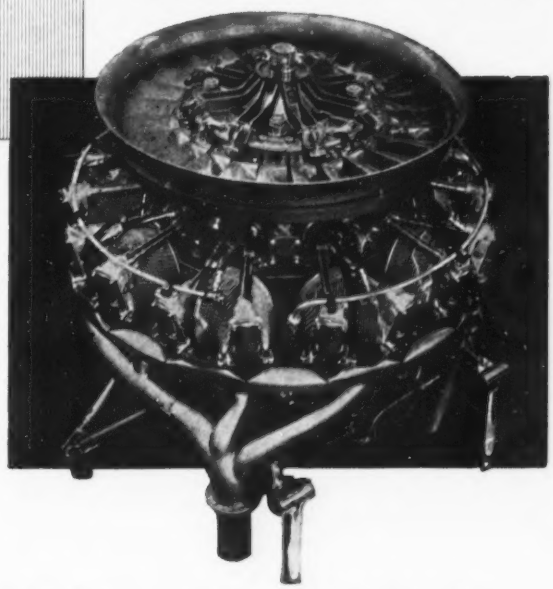

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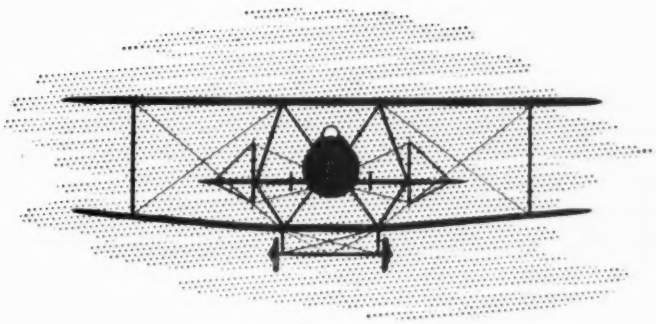

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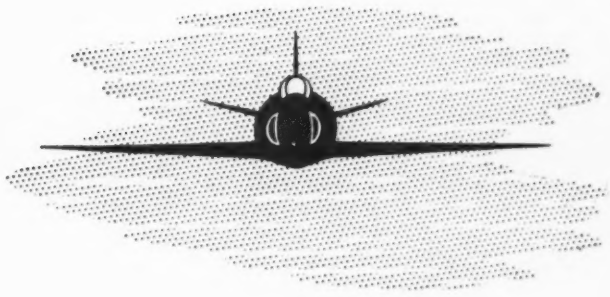

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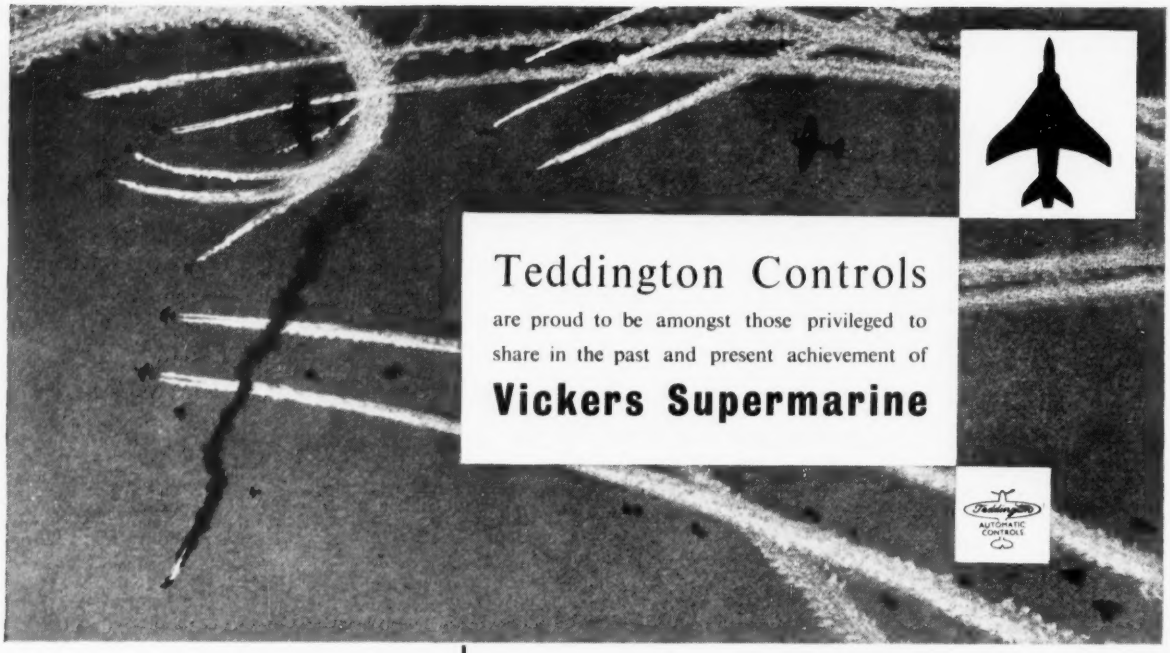

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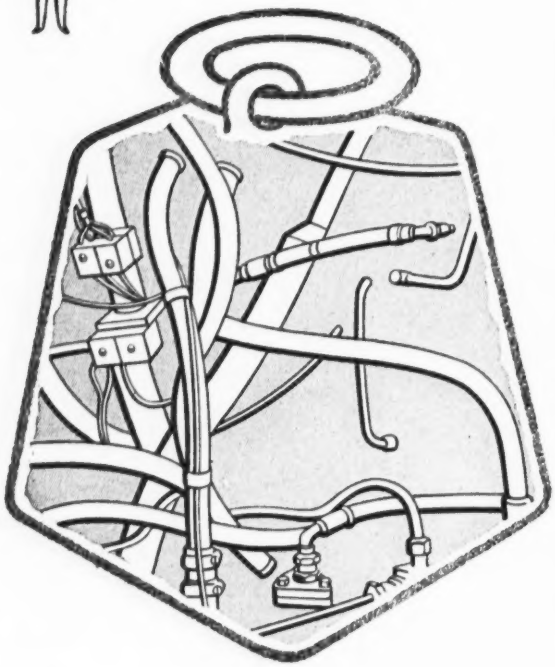

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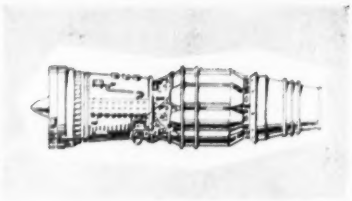

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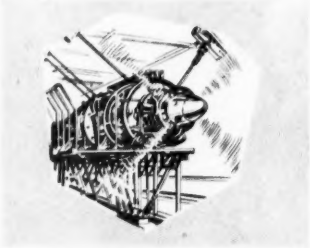

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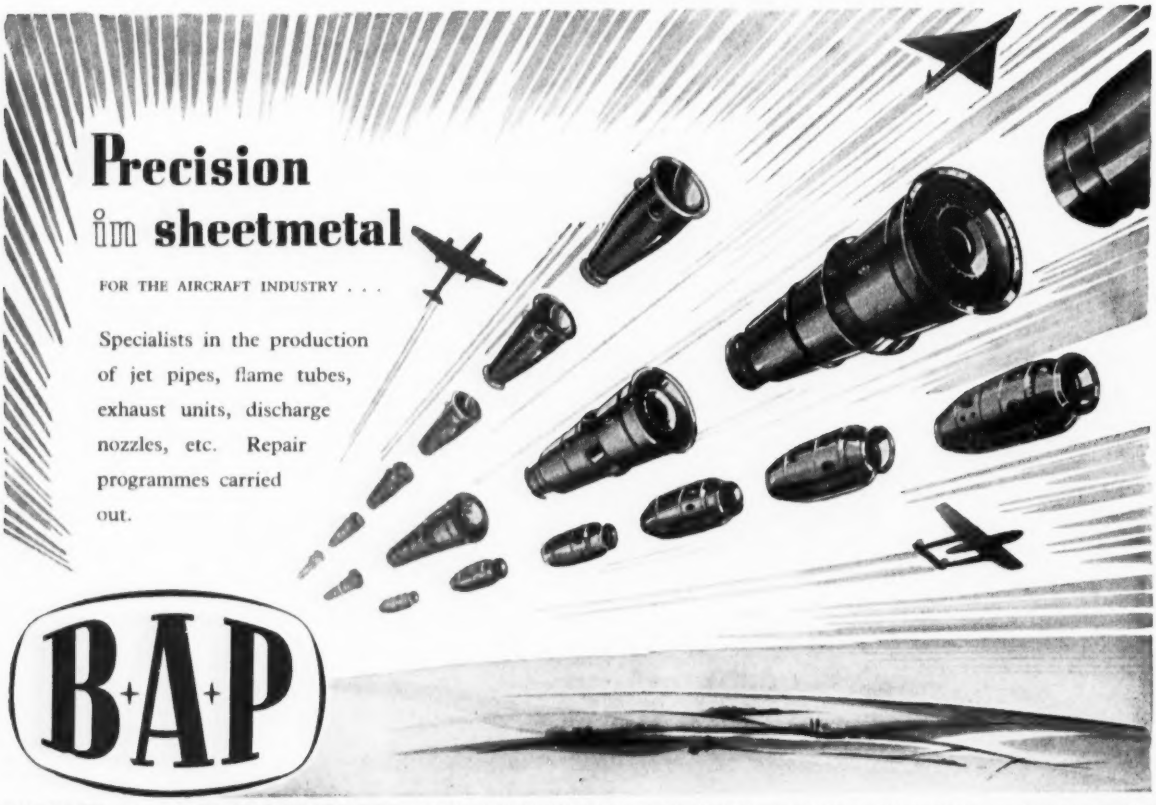

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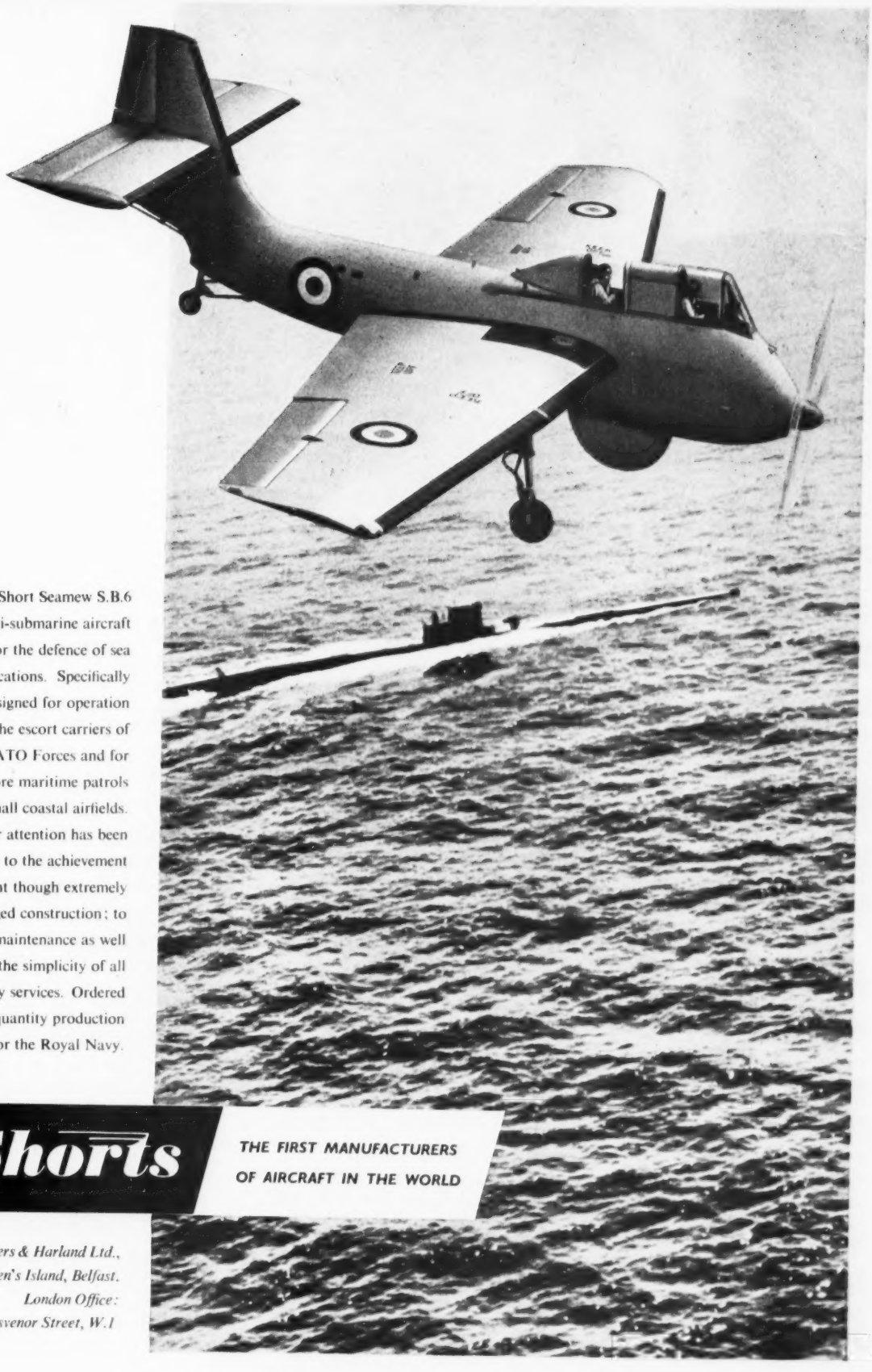

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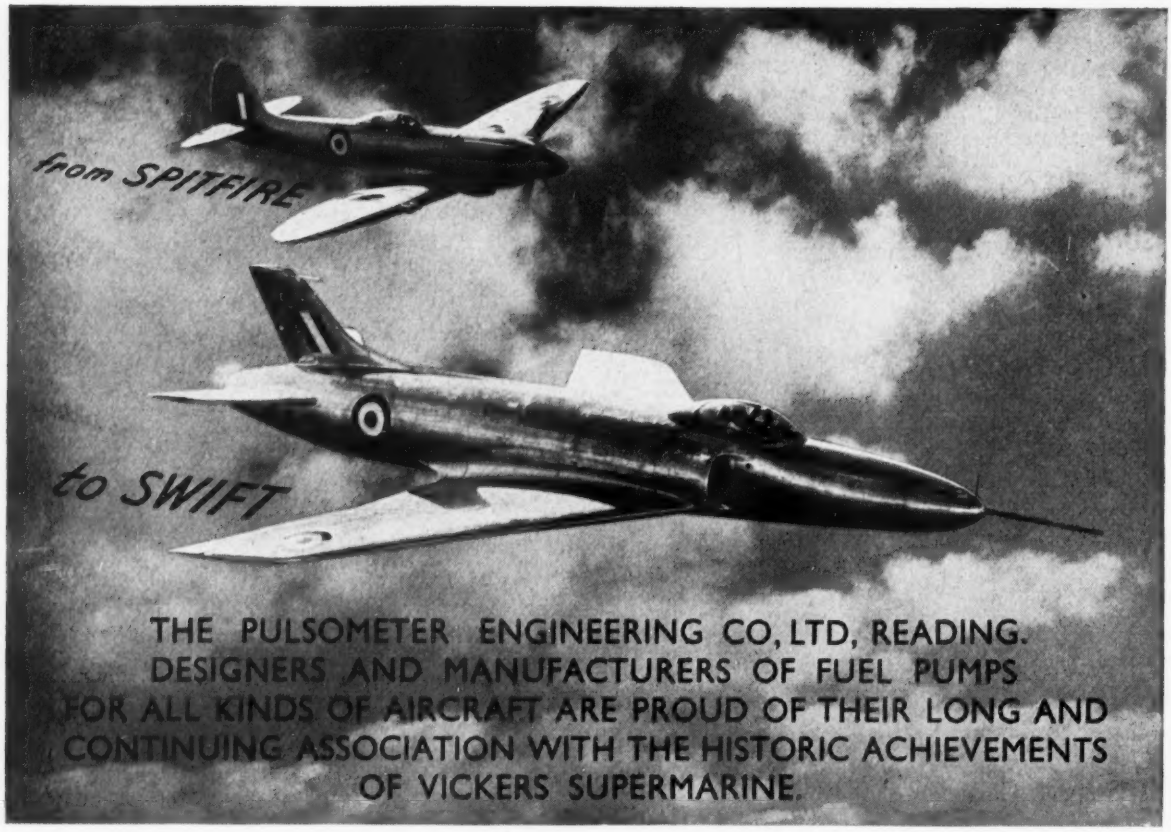

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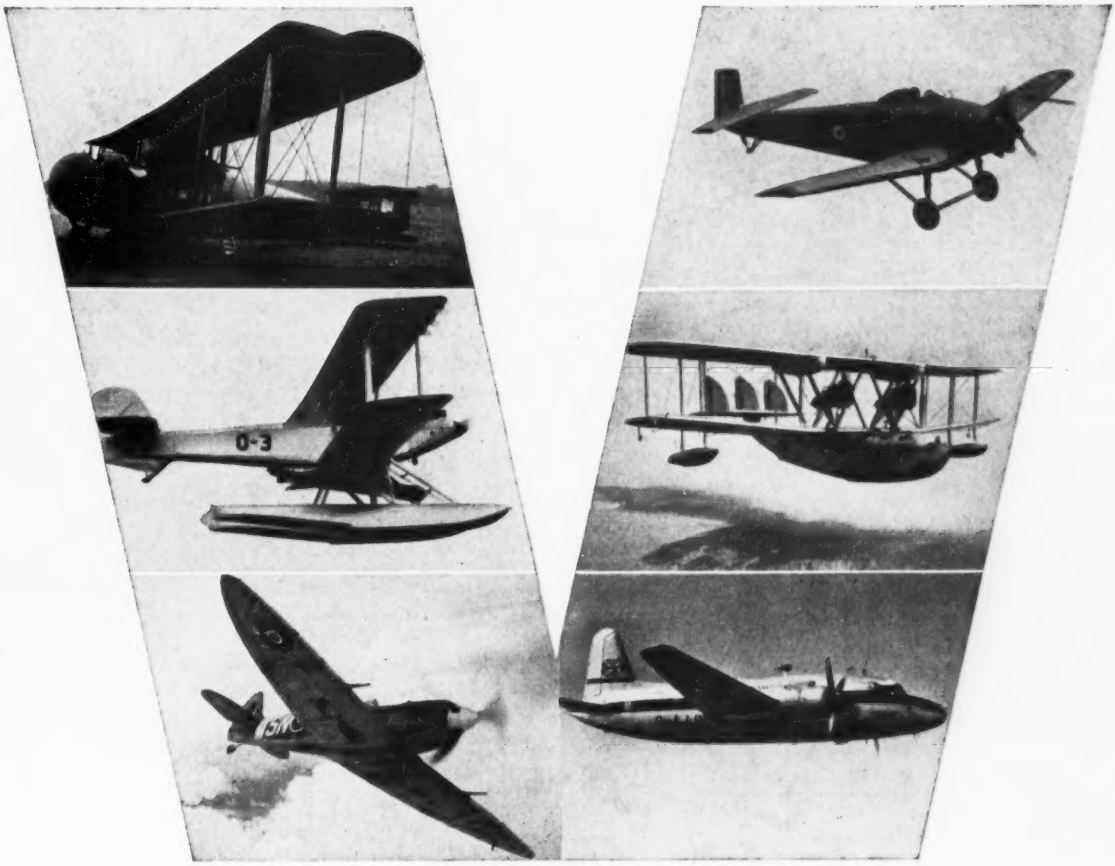

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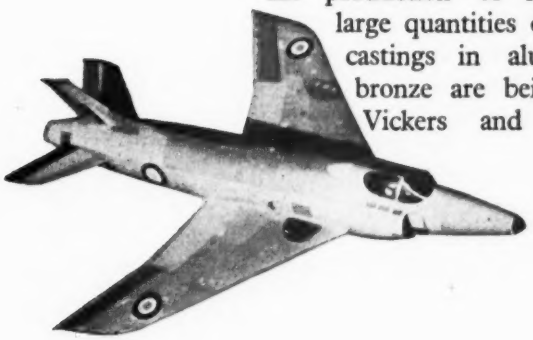

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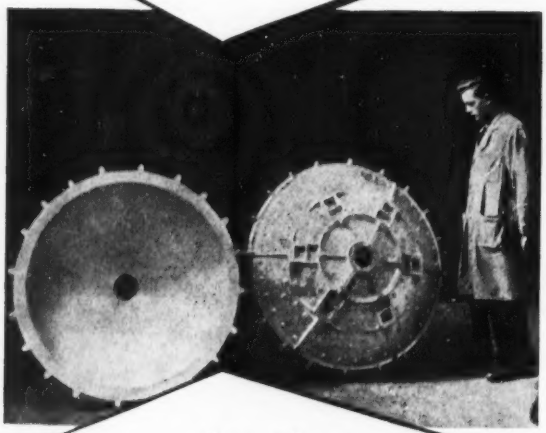

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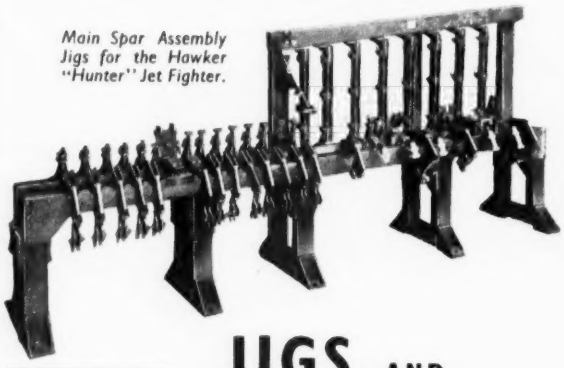

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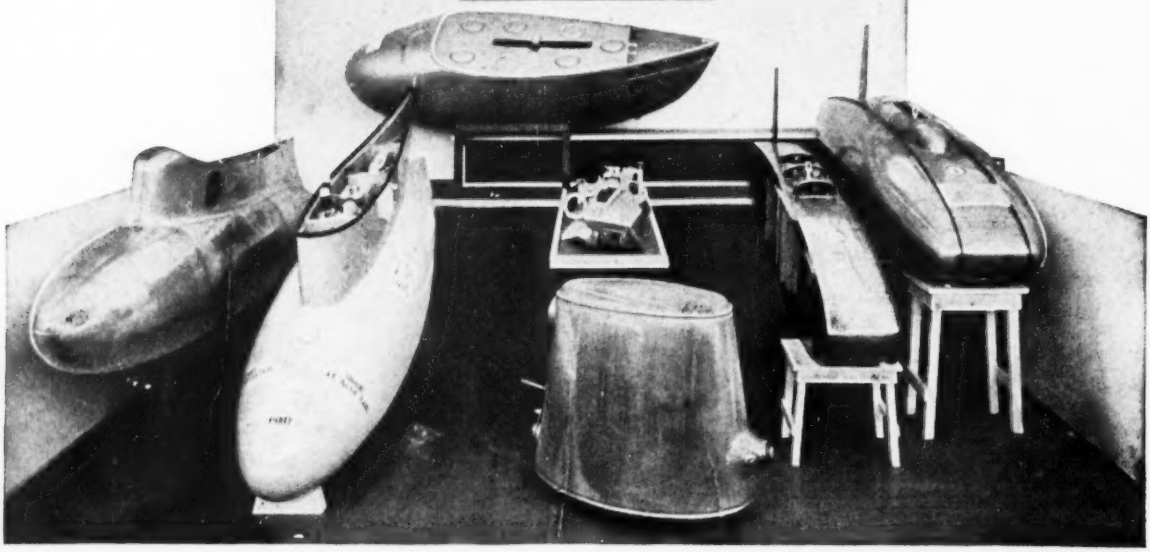

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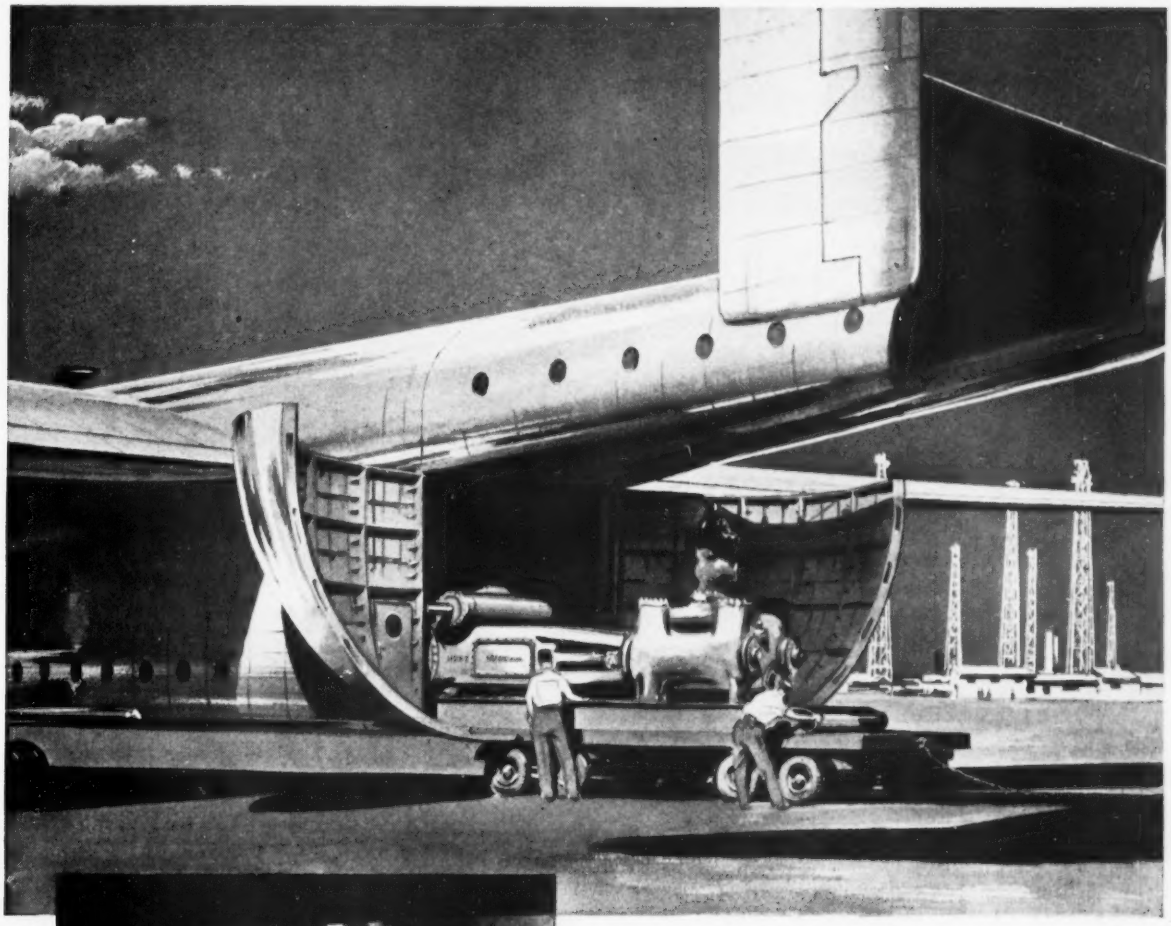

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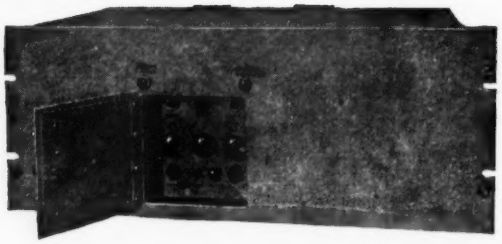

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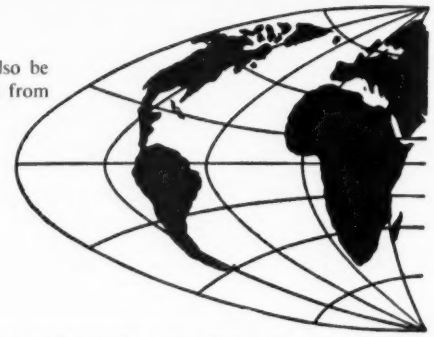

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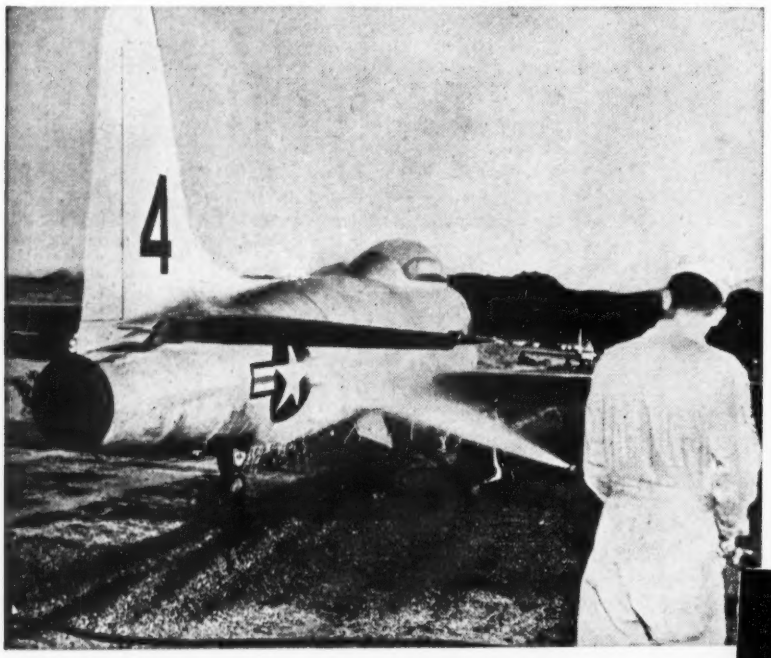

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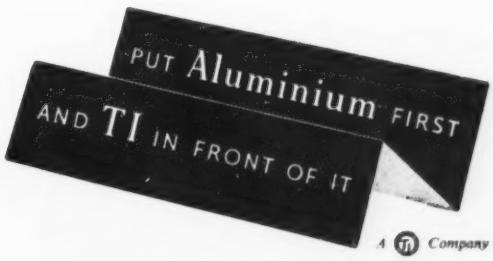

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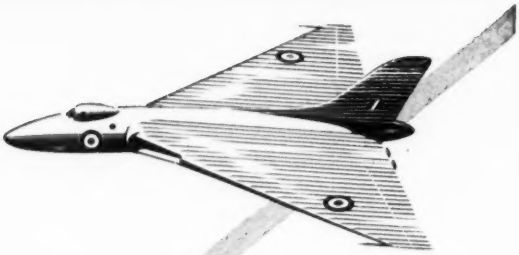

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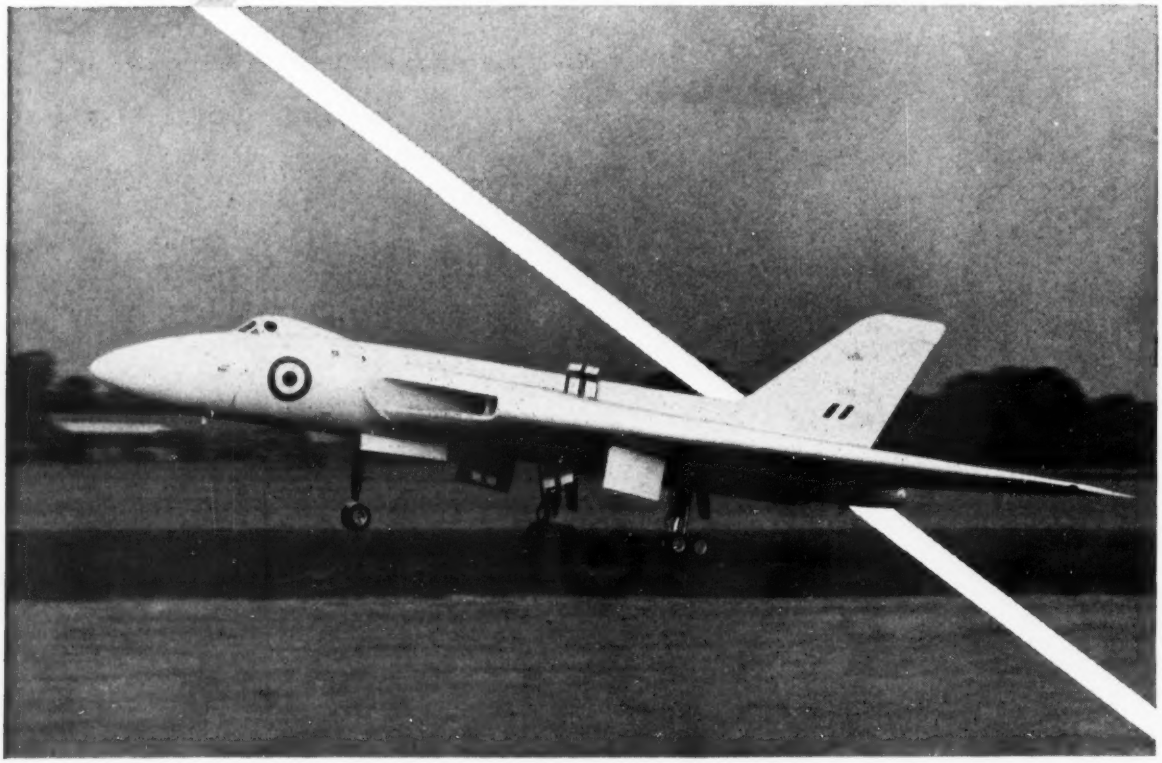

FLIGHT
and
AIRCRAFT ENGINEER

First Aeronautical Weekly in the World

Founded 1909

No. 2332 Vol. LXIV. FRIDAY, 2 OCTOBER 1953

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LONDON, S.E.1.

Telegrams, Flightpres, Sedist, London.
Telephone, Waterloo 3333 (60 lines).

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Supermarine Record

THE bulk of this issue is devoted to the products and achievements of one of the great companies of the British aircraft industry during forty years of existence. Any apprehension which might be felt that twenty pages of history would prove heavy going for any readers whose minds are preoccupied with entirely modern affairs will, we feel sure, be dispelled by perusal of no more than a paragraph or two. From the beginning the story of Supermarines is one of enterprise and adventure. There will be few so unimaginative as to be left unmoved by recollections of the exploits of Schneider Cup Race days, and, after the trophy had been won outright, of the building of the Spitfires just in time to play their historic part in the Battle of Britain.

Just now speed records and races are very much in the public eye. It is not always easy to justify the cost and loss of ordinary development time which may be occasioned by such attempts; yet on reading through the pages devoted to the company selected for this, our latest historical article, one cannot but be impressed both by the stimulating effect resulting from the striving for ever-higher speeds and by the technical knowledge and experience which have been derived directly from aircraft specially prepared for racing or record.

That the Supermarine Swift should, during the time of preparation of this issue, have achieved the highest speed under low-level world-record conditions is a happy coincidence. It should be taken, perhaps, as an indication of the changed circumstances that Mike Lithgow's flights had to be carried out in Libya in order to take advantage of the high temperature. This helped him to better Duke's figure established in the Hunter.

In America, sonic speed has already been achieved in level flight, though not yet, we believe, at low level, and in some quarters it is felt that the rules governing the international speed record will have to be revised. It is to be hoped that the sound barrier will not put a stop to speed-record attempts as we know them, for they have in the past subscribed much to the spirit and technique of aviation.

Dividends and Deficits

ALMOST simultaneous publication of the airline Corporations' annual reports (which, incidentally, always prove more informative than comparable documents) makes this an appropriate occasion for consideration of their joint achievements—and the two national airlines have achieved a great deal, first in keeping up with stiff foreign competition and now in setting the pace. We are not among those who believe that the State operators can do no wrong, but, remembering that they have grown at an unprecedented rate into major companies, we feel that they have good cause to be proud of their achievements to date. Most air travellers will agree that both B.O.A.C. and B.E.A. are a credit to the nation.

What of the problems as indicated in their report? B.O.A.C., who weathered a difficult year and successfully pioneered jet travel, will be readily forgiven for proclaiming a small profit which somehow emerges in this year's books as a small, built-in deficit. The main thing is that the Corporation received no Treasury grant and operated at no cost to the tax-payer. Nearer home, we observe that the consistency of B.E.A.'s losses over the last three years (and the observation is in no sense derogatory) confirms the belief that the current combination of tasks faced by this conscientious and enterprising team is not compatible with the achievement of a profit in the commercial sense.

In speaking of profits, we might ask just how many national airlines do show a real profit without subsidy. The subsidies paid to foreign operators may either be hidden or paid openly as the accepted price of air-transport progress, but rarely are they regarded on the books as downright deficits. The Corporations contend, not without justification, that to have to declare a deficit under these circumstances is bad, variously, for staff morale, the airlines' reputation and for national prestige.

Both airlines have made representations on the subject, in each case for different reasons. Their brief should be made quite clear. Is it simply to operate at a profit year by year, or is it also in addition to develop British air routes and airliners and to keep open social services even if they are unprofitable? As B.E.A. point out, the question is essentially one of national book-keeping, and it seems to merit reconsideration.

FROM ALL QUARTERS

The Swift's Record Speed

SINCE S/L. Neville Duke first attempted to break the world's speed record in the scarlet Hawker Hunter prototype at the beginning of the month, the speeds have been twice raised, first off the South Coast of England—during the triumphant second attempt by Duke himself—and then in Libya. The Swift F.4, piloted by Lt. Cdr. M. Lithgow, flew to Libya on September 21st to make an attempt over a course laid out along a straight stretch of desert road between Castel Idris and Azizio.

It was hoped to take advantage of high ambient temperatures in order to raise Neville Duke's record of 727.6 m.p.h.—which awaits F.A.I. confirmation—but in the event these very conditions caused considerable inconvenience both to those on the ground and to the pilot himself. During a preliminary run on Thursday, the 23rd, and on subsequent occasions, the cockpit temperature in the Swift reached 180 deg F, and the pilot's cooling suit was not functioning satisfactorily.

On Friday a serious attempt on the record was made in an ambient temperature of 102 deg and in bumpy air. But this time a fuel gauge failed and, left in uncertainty as to the amount of fuel he would have in hand, Lithgow decided to ignite the Avon's reheat only five miles before entering the measured three kilometres, instead of ten miles before as originally planned. Secondly, the valve of his oxygen mask jammed as a result of excessive sweating during the previous day's practice flight, and he was forced to rip the mask off during one of his passes at the measured course while flying at between 70 and 100ft. The action of ripping away the mask while travelling at nearly 750 m.p.h. resulted in slight "jinking" which—reports an eye-witness—caused some anxiety among the ground observers.

Lithgow was up against yet another difficulty when he found that the smoke indicators, laid to enable him to pick up his course over the featureless desert, were inadequate; on his third run he nearly missed the course altogether.

In spite of all these obstacles, the pilot achieved an average speed of 737.3 m.p.h. for the four runs. Speeds on each run were 1st, 743.6 m.p.h.; 2nd, 729.5; 3rd, 745.3; 4th, 730.7.

Further attempts were in any case intended, but although, during a subsequent attempt on Saturday, this speed is believed to have been raised, the recording mechanism broke down owing to the heat, and the after-burner began to give trouble. The aircraft was then due for an engine change, and the timing equipment could not be repaired in time for another attempt on Sunday. Because of this, Friday's speed of 737.3 m.p.h. was to be submitted to the F.A.I. in Paris for ratification as a new world's speed record.

There is a possibility that the Hawker Hunter will be used in an attempt to regain the record in a "new" hot foreign climate. Sir Frank Spriggs, managing director of the Hawker Siddeley group, has stated that the Hunter might be sent to Muroc, California, where conditions are ideal for high-speed flights.

Meanwhile, from the United States came news of an attempt to raise Mike Lithgow's record. The aircraft was the Douglas Skyray, built for the U.S. Navy, and flown by Lt. Cdr. James Verdin, whose first attempt on Saturday, September 25th, was postponed because of high winds. The next attempt, on Sunday, was likewise postponed, this time owing—by an odd coincidence—to an unserviceable fuel gauge. These attempts were made over the Salton Sea lake-bed in California, and on Monday Verdin tried again; the F4D delta achieved 742.7 m.p.h., i.e., 1.6 m.p.h. short of the one per cent margin necessary to beat the Swift. He was to fly again on Tuesday. Vickers-Supermarine indicated that Lithgow would try again this week, after overhaul of the timing apparatus.

What is, perhaps, the most formidable record attempt, that of the North American F-100, is still to come. It is possible that the F-100, which has already exceeded Mach 1 in level flight, will for the first time raise the world's speed record, which must be made at less than 100 metres altitude, beyond the speed of sound.

As we go to press, confirmation of Duke's record, at 727.6 m.p.h., is announced (previous holder, Capt. J. Slade Nash, F-86D, 698.5 m.p.h.). Duke's closed-circuit 709.2 m.p.h. is also ratified as a class and world record.

Aerodrome Owners at Newcastle

MORE than 50 members and guests of the Aerodrome Owners' Association attended the 1953 Conference, which was held in Newcastle-upon-Tyne at the invitation of the Association's chairman, Alderman R. Mould-Graham, who is also chairman of Newcastle's municipal airport committee.

The two-day conference opened on September 23rd with a visit to Woolsington Airport, where delegates inspected Newcastle Aero Club's fleet of Tiger Moths and Austers.

Over coffee in the airport restaurant, Alderman Mould-Graham and the airport manager, Mr. Denyer, announced plans to extend and modernize Woolsington at a cost of £116,000. Improvements will include extension of the present 1,050-yd asphalt runway by 600 yd, extension of the parking apron, a new taxi track, enlargement of the passenger and Customs sheds and erection of a new three- or four-storey control tower.

After reception by the Deputy Lord Mayor of Newcastle and luncheon in the Town Hall, the conference heard a talk by W/C. "Reggie" Brie (who is i/c B.E.A.'s Helicopter Experimental Unit) entitled *Where is the Helicopter?* It brought little cheer to those aerodrome owners who have lost a high percentage of their revenue following closure of R.A.F. Reserve schools; because, although W/C. Brie foresaw the eventual usefulness of small private airfields as helicopter airbus maintenance stations, he

THE SCORCHER: Lt. Cdr. "Mike" Lithgow, seen framed in the eye of the Swift's Avon jet-pipe (right), is shown below traversing the 3 km course on the Azizio plain, Libya, during his successful attempts on the world speed record, as related on this page. The spectator (below left) is Col. Preston of the Royal Aero Club. Below, right, the observers are seen grouped round the timing apparatus as the Swift comes up to one end of the course.

thought that "airbus" services were at least seven to ten years away. For the present, he believes, helicopters should be regarded as air taxis rather than airbuses, because if people are prepared to pay taxi-fares six or seven times 'bus fares just for convenience, they would probably pay £1 to travel from a crowded city to an airport in ten minutes by helicopter instead of 5s and 40 minutes by coach.

Most of the remainder of the conference programme was on a less serious note, consisting of visits to places of interest.

Perhaps the most striking lesson learned by many delegates was the value of Hunting Air Transport's internal service between Bovingdon and Woolsington. Some were in their offices in London at 5.45 p.m. on the 22nd, and in hotels in Newcastle 3¼ hours later. Returning by the evening service on the 24th, they spent only two days away from home, compared with 3½ days by their less air-minded colleagues. Their expenses were down by one night's accommodation and meals to match, and at a cost of only 7s 2d more than first class rail fare, plus a total of 12s for airport-to-town coach fares.

Stansted Initiative

GIVEN enthusiasm and an airport, what can be done by a small R.A.F.A. branch was convincingly shown at Stansted on Saturday last. The air display organized by No. 951 (Stansted) branch of the Royal Air Forces Association—with only 90 members—brought to the airport some 7,000 spectators to see an excellent and varied flying show, backed by a comprehensive static exhibition. A full report will appear next week.

Flight Refuelling Developments

THE BOARD of Flight Refuelling, Ltd., has recently been strengthened by the appointment of Mr. Bonner W. A. Dickson, C.B.E., who was formerly director and general manager of the aircraft section of Vickers Armstrongs. His election is stated to coincide with an important programme of expansion.

Returning to the company after a brief absence in Canada is W./C. H. C. Johnson, whose new post is termed "special representative for the exploration and development of new fields of activity." W/C. Johnson was an associate of Sir Alan Cobham for many years, and held important positions in Flight Refuelling, including that of operations manager (1946-9), after having been a founder of the company in 1934.

A completely new line of development, which can only now be mentioned, is the entry of Flight Refuelling into the aircraft-manufacturing industry, as principal sub-contractors to Armstrong Whitworth. In this capacity they are building the rear fuselages of the large number of Hawker/Armstrong Whitworth Sea Hawk fighter/bombers now being built—partly against an "off-shore" contract—for the Fleet Air Arm. We understand that the Sea Hawk contract is only a part of the extensive expansion.

Handley Page Appointment

FROM Handley Page, Ltd., comes news that Maj. R. E. Nicoll is relinquishing his position as their sales manager, in order to take up the post of commercial manager of Westminster Airways Servicing, Ltd; there he will continue to work with A. Cdre. A. V. Harvey, who is chairman of Westminster Airways Servicing as well as deputy-chairman of Handley Page, Ltd.

G/C. Collard.

Succeeding Maj. Nicoll is G/C. R. C. M. Collard, D.S.O., D.F.C., who retired recently from the R.A.F. Now forty-two years old, he was educated at Haileybury and commissioned in the R.A.F. in 1931. He served with Nos. 4 and 615 Squadrons and as a flying instructor before the war and played rugby for the R.A.F. Serving during the war with the Advanced Air Striking Force in France, in Bomber Command and in the Middle East, he commanded Nos. 37 and 12 Squadrons.

G/C. Collard was in command of the Lancaster goodwill tour of the U.S.A. in 1946. Subsequently, he commanded R.A.F. Station Stradishall for two years, was in charge of development at the Central Bomber Establishment in 1948/49, served as Group Captain Operations in the Middle East Air Force in 1950/51, attended the Imperial Defence College in 1952 and was Group Captain Operations, Coastal Command, until August 1953. He has flown 3,000 hours as pilot on forty-five different types of aircraft.

THE DOCILE VICTOR

ALTHOUGH the secretary of the U.S. Air Force, Mr. Harold E. Talbott, chose strange terminology when he likened the Handley Page Victor to a baby carriage, it was quite clear what he implied. After flying in the first prototype, both as passenger and pilot, he was impressed with the viceless flying qualities of the machine and with its consummate ease of handling.

Even more noteworthy than the all-round ease of handling is the claimed capacity of the Victor to "land itself," once placed in a correct approach configuration. Sir Frederick recently had this quality demonstrated to many of the American delegates to the R.Ae.S.-I.A.S. conference. The date was the Monday following the S.B.A.C. show, and the weather was fine but exceptionally gusty. The firm's chief test pilot, S/L. H. G. Hazelden, brought the Victor back from Farnborough to Radlett, where he put on a flying demonstration which was brief but noticeably not subject to the restrictions of the previous week.

American engineers are here being shown the cockpit of the Victor by S/L. Hazelden (right). Although the big roof hatches are open, the normal method of entry is via a large door on the port side of the nose.

He then brought the Victor in and took on board Lt. Cdr. D. P. Davies, chief test pilot of the Air Registration Board, who settled himself into the Victor's right-hand seat. He had been wisely invited to act as an impartial observer so that the demonstration could not be termed "bull" (we quote Sir Frederick).

The Victor was absent while Hazelden carried out handling tests and steep turns and briefed his passenger on the intricacies of the Victor's cockpit. Hazelden then—according to Davies—turned on to final at 1,100ft and held the aircraft in a steady approach. At 800ft there was slight re-trimming, and the power levers for the four Sapphires were then locked. At 600ft, and some 130 knots, Hazelden ceased all elevator movement and merely applied slight aileron and rudder deflections to counteract the violent gusty wind, which was blowing directly across the runway. From then on the Victor was left to its own devices and, having settled on to its bogies, was rapidly brought to rest.

To us the landing appeared quite normal, and it could not derisively have been called an "arrival." There was some transfer of weight from one bogie to the other, with consequent load on the Electro-Hydraulics anti-pitch dampers, but the brakes were on after some 500yd and the Victor pulled up with about one-third of the runway remaining. Later S/L. Hazelden came across and said how pleased he was with the aircraft. The "self-landing" characteristic, he said, resulted from the aircraft having a strong tendency to trim nose-up as ground effect became noticeable. The characteristic was valuable in that, in rain or bad visibility, he could bring the Victor in gently with power on and all the flaps and air brakes open. All that was required then was to correct for local air disturbances affecting lateral trim until eventually the bogies could be heard rumbling on the concrete. Then the nosewheels would be brought on to the runway and the wheel brakes applied.

For his part, Lt. Cdr. Davies said that the A.R.B. were at present particularly interested in powered controls, and those of the Victor appeared excellent, with progressive feel simulation. His impression of the Victor had been most favourable and—obviously speaking "off the cuff"—he did not expect that Sir Frederick would have much difficulty when the H.P.97 transport came to his department for certification.

THE ENGLAND-NEW ZEALAND RACE

Twelve Aircraft to Race Half-way Round the World

NEXT Thursday, October 8th, twelve aircraft will leave London Airport to begin the England to New Zealand air race for the Harewood Gold Cup. They are divided into two groups, the speed section and the transport handicap section.

In order to allow aircraft in the high-speed section to land in New Zealand by daylight, the start has been arranged for 4.30 p.m., the aircraft taking off at short intervals, with the speed section last. The aircraft will be started by H.R.H. the Duke of Gloucester.

The public will be allowed to inspect the competing machines, parked in the central area of London Airport from Monday, October 5th, until Wednesday, October 7th, admission charges being those for the normal public enclosure. During this period, none of the aircraft may fly without written permission of the race authorities. On the day of the start itself, the central area will be open to the public from 11 a.m. onwards with the following admission charges: pedestrians 1s, cars (including occupants) 5s, motor cycles (including riders) 2s 6d, cycles (including riders) 1s 6d, double deck coaches (including occupants) £3 10s 0d, single deck coaches (including occupants) £2 10s 0d. There will be no advance booking. Access to the viewing area will be *via* the road tunnel from the Bath road to the new Terminal Area.

This is the first time that a race of this type has been flown since 1934, when the McRobertson London to Australia race was held, and won by the Gipsy Queen-powered de Havilland aircraft of the type which first bore the name Comet. One of the competitors, Capt. Woods, who is flying an Australian Mosquito 41, flew in the 1934 McRobertson race in a Lockheed Vega.

The changes which have taken place since the days of the first race are indicated by the fact that six of the eight high-speed entries are turbojet powered, and that one of the transport handicap section is turboprop-powered. Ranges and speeds have increased to such an extent that most of the aircraft in the high-speed section hope to complete the course—which measures a Great Circle distance of 11,796 statute miles—in 24 hours, and one of the Mosquitoes and the Valiant have planned to make only two refuelling stops.

There will be four prizes in each section of the race; £10,000 first prize and £3,000, £1,000 and £500 for second, third and fourth places. The winner of the speed section will also receive the Harewood Gold Cup. There are now four entries in the transport handicap section.

TRANSPORT SECTION

Racing No.	Aircraft	Engines		Captain	Entrant
		No.	Type		
21	Douglas DC-6A	4	Pratt and Whitney Wasp C8-17	Capt. H. A. A. Kooper	K.L.M. Royal Dutch Airlines
22	Handley Page Hastings C.3	4	Bristol Centaurus 737	W/C. R. F. Watson, A.F.C.	R.N.Z.A.F.
23	Vickers Viscount	4	Rolls-Royce Dart 505	Capt. W. Baillie (B.E.A.)	British European Airways
24	Lockheed 18-56 "Hudstar"	2	Wright 1820-G.205A	V. Reavely	Rausch Aviation (U.S.A.)

SPEED SECTION

Racing No.	Aircraft	Engines		Captain	Entrant
		No.	Type		
6	De Havilland Mosquito 41	2	Rolls-Royce Merlin 77	A. J. R. Oates	A. J. R. Oates (Australia)
8	De Havilland Mosquito 41	2	Rolls-Royce Merlin 69	Capt. J. Woods	Capt. J. Woods
1	English Electric Canberra P.R. 7	2	Rolls-Royce Avon Ra 7	W/C. L. M. Hodges, D.S.O., D.F.C.	R.A.F.
2	English Electric Canberra P.R. 3	2	Rolls-Royce Avon Ra 3	S/L. L. G. Press	R.A.F.
3	English Electric Canberra P.R. 3	2	Rolls-Royce Avon Ra 3	F/L. R. L. E. Burton, A.F.C.	R.A.F.
4	English Electric Canberra Mk 20	2	Rolls-Royce Avon Ra 3	W/C. D. Cuming, A.F.C.	R.A.A.F.
5	English Electric Canberra Mk 20	2	Rolls-Royce Avon Ra 3	S/L. P. Raw, D.F.C.	R.A.A.F.
10	Vickers Valiant B1	4	Rolls-Royce Avon Ra 14	S/L. R. G. W. Oakley, D.F.C., D.F.M.	R.A.F.

* *Aircraft in both these tables are listed in starting order.*

K.L.M. DC-6A entry. Racing No. 21.—Perhaps the most potent entry in the transport handicap section, and the most likely to win, is K.L.M. Royal Dutch Airlines' DC-6A, whose race flight is also being treated by K.L.M. as a normal commercial charter flight. Fifty-three Dutch emigrants, six fare-paying passengers, and five journalists invited by K.L.M., with freight and some 60,000 air mail letters, will make up the DC-6's load. The operating weight of the aircraft is to be kept constant throughout the flight, and since the stops will be short and some 50 hours will be spent in the air, no children will be carried, and passengers will have special containers under their seats for items "wanted on voyage."

The crew will consist of 11 members. The captain will be Capt. Henry A. A. Kooper. He will be assisted by J. F. Griffith, an Australian (first officer), P. J. Aarts (second officer), J. I. Noomen (third officer), J. M. C. Kiepe (first radio operator), J. van den Bos (second radio operator), H. van der Ham (first flight engineer), W. F. J. Tielman (second flight engineer). Three teams of stewards will serve during one third of the journey each. Besides the flight crew, Mr. D. A. Visser, head of K.L.M.'s flight planning office, will travel as "paper pilot" to advise the captain on the procedures most desirable in complying with the handicap regulations. The route to be followed includes eight stages with refuelling stops at Athens, Dharhan, Bombay, Colombo, Cocos Island, Perth and Melbourne.

The DC-6A: Its large capacity, high speed and long range, and the meticulous planning which has gone towards the making of the journey may well bring victory to the Dutch entry. The maximum take-off weight of the DC-6A is 107,000 lb and the cruising speed, 295 m.p.h.

New Zealand Hastings entry. Racing No. 22.—The Royal New Zealand Air Force has entered a Handley Page Hastings C.3 powered by four Bristol Hercules engines in the transport handicap section of the race. The aircraft, which is drawn from No. 41 Squadron, R.N.Z.A.F., will be carrying a comprehensive flight crew to allow continuous flying without rest periods, as well as a servicing party, a medical officer, a meteorologist and two civilian journalists. The crew will be composed as follows:—Aircrew: pilots, W/C. R. F. Watson, A.F.C. (captain), S/L. C. L. Siegert, D.F.C., F/L. K. B. Smith, F/L. L. A. R. Hill. Navigators: F/L. R. J. H. Myhill, P/O. G. C. Patterson, Sgt. I. A. Johnson. Signallers: F/L. A. F. Jacobsen, A.F.C., P/O. G. R. Blackett, Sgt. J. Hobdy. Flight engineers: Master Engineer D. M. Stark, Sgt. H. W. E. Bromley, Sgt. A. Rose. Air Quartermasters: Sgt. S. B. Bryan, Sgt. R. L. Horne. Servicing party: seven N.C.O.s and airmen under the command of F/L. J. D. Hurley. Specialist officers: S/L. R. J. Croke (medical officer), S/L. L. N. Larsen (meteorologist). Two journalists will be travelling in the aircraft. An unspecified quantity of freight will be carried as payload.

The Hastings will make the journey in eight stages, refuelling at Athens, Shaibah, Masirah, Negombo, Cocos Island, Perth and Melbourne.

The Hastings C.3 has a cruising speed of 250 m.p.h. and maximum range of 3,000 miles. Its all-up weight will be 83,000 lb and its payload more than 10 short tons. On board will be 27 people, including the crew. No extra fuel tanks have been fitted for the race.

The American-entered Lockheed 18-56 "Hudstar."

K.L.M. DC-6 crew: standing before the aircraft, Capt. Kooper, first officer J. F. Griffith, second officer J. I. Noomen, radio officer J. M. C. Kiepe, radio officer J. van den Bos, first engineer H. van der Ham, second engineer W. F. J. Tielman, together with the first team of stewards. (Left) Standing with Capt. Kooper is D. A. Visser, "paper pilot."

B.E.A. Viscount race crew during practice: Mr. P. Masefield, team leader (wearing glasses), and Mr. J. D. Profumo, M.P., stand by the aircraft with the B.E.A. flight crew after a practice flight.

R.N.Z.A.F. entry: the Hastings C.3 (below) on arrival in England. (Above, left) W/C. Watson, captain, and (right) S/L. Siegert, second pilot.

B.E.A. Viscount entry. Racing No. 23.—British European Airways have entered a Viscount V.700 prototype, registered G-AMAV, in the transport handicap section of the race. The aircraft is, in fact, the property of the Ministry of Supply, but has been loaned to B.E.A. Long-distance practice flights were made during last week and final preparations are now complete.

The crew will consist of the following: the team manager will be Mr. P. G. Masefield, M.A., F.R.Ae.S., chief executive, B.E.A.; Capt. W. Baillie, A.F.R.Ae.S. (chief flight captain, B.E.A.) will be the pilot in command, and will be assisted by Capt. A. S. Johnson, D.S.O., D.F.M. and bar (pilot), Capt. S. E. Jones, D.S.O., D.F.C. (pilot), R. H. Chadwick (navigation officer), I. A. Dalgleish (radio officer), E. H. S. Bristow (radio officer), E. W. Walker and R. Shaw of Vickers-Armstrongs (flight engineers), S. R. Jones of Rolls-Royce (flight engineer), and Mr. J. D. Profumo, O.B.E., M.P., Parliamentary Secretary, M.C.A. (supernumerary). Apart from being team manager, Mr. Masefield will also assist in the flying of the aircraft.

At the time of going to press the route of the Viscount had not been finalized, but is thought to entail about 14 stages. All flight plan data for each successive stage will be notified to the aircraft in advance by radio.

The Viscount is the only turboprop transport in service in the world and its performance will therefore be carefully watched by operators of many nations. It may well surprise us all by the speed at which it covers the route to Christchurch. In its operational form it has a cruising speed of 277 m.p.h. at 20,000ft. The race aircraft recently flew non-stop from Beirut to London, giving some indication of the range expected with the fuel load to be carried during the race.

Rausch Aviation "Hudstar" entry. Racing No. 24.—Rausch Aviation of Teterboro Airport, New Jersey, U.S.A., have entered a composite aircraft known as a Lockheed 18-56 and nicknamed "Hudstar," in the transport handicap section of the race. The company specializes in the reconstruction of wrecked aircraft and is one of the only two companies in the U.S.A. engaged on this work. The "Hudstar" was re-built and modified from the remains of a Hudson and a Lodestar; hence its name.

The captain of the "Hudstar" in the race will be Vincent J. Reavely. A licensed aircraft mechanic and one-time flying instructor to the U.S. Army Air Corps, he flew C-46 Commandos on the wartime India to China air lift. Since the war, he has become an airline pilot and has over 8,000 flying hours.

His co-pilot will be James C. Chaudoin, who served with the U.S. Naval Air Arm until 1946. He has since been an airline pilot and has more than 5,500 flying hours. The navigator will be Richard W. Haitch, who flew with the U.S.A.F. in the south-west Pacific during the war, and subsequently became copy editor on a New York newspaper. The route to be followed by the "Hudstar" has not yet been notified; neither is anything known of the load (if any) it is intended to carry, or of the capabilities of this particular aircraft. It is in fact an almost totally unknown quantity.

"Hudstar": Figures available for the Lodestar model 18-56 with the same engines, indicate a cruising speed on 65 per cent power of 246 m.p.h. at 19,000ft. By installing extra tankage, the range of this aircraft has probably been increased beyond the standard Lodestar's 1,690 statute miles at 50 per cent power.

Mosquito 41 entry (S/L. Oates). Racing No. 6.—A Mosquito 41 has been entered in the race by S/L. A. J. R. Oates, D.F.C. This aircraft is an Australian-built high-level P.R. machine, and is one of many sold by the R.A.A.F. as war surplus. For the race it has been re-engined with Rolls-Royce Merlin 77s.

S/L. "Titus" Oates served with Nos. 4 and 14 Squadrons in the Far East and was awarded the D.F.C. for a low-level bombing attack in a Beaufighter at Rabaul. From 1949 until 1952 he was senior test pilot to the Australian de Havilland company, and on resigning flew Lockheed Lodestars on an airline between Australia and Italy. He has over 6,000 flying hours on more than 54 types. As well as being a pilot, he is a qualified specialist navigator. S/L. Oates has as his co-pilot F/L. D. H. Swain, D.F.C., manager of *Sydney Morning Herald* Flying Service. He was awarded the D.F.C. during bombing operations in Europe with No. 8 Group, Pathfinder Force. After the war he flew for Australian National Airways and has over 6,000 flying hours.

S/L. Oates plans to make only two refuelling stops during the race, and to take full advantage of the Mosquito's long range and possible 400 m.p.h. at 40,000ft. The aircraft was due to arrive in England on September 27th.

Mosquito 41 entry (Capt. Woods). Racing No. 8.—Capt. James Woods, head of Woods Airways Pty., Ltd., has entered another Mosquito 41, powered by two Rolls-Royce Merlin 69s. The standard tankage is 850 gallons, including two 100-gallon wing tanks. Capt. Woods is thought to have installed extra tankage for 350 gallons in the aircraft.

Capt. Woods has to his credit over 500 crossings of the Indian Ocean, and 21,000 flying hours. He took part in the 1934 MacRobertson race from England to Australia in a Lockheed Vega. His navigator on that occasion was Don Bennett,

THE ENGLAND-NEW ZEALAND RACE . . .

now A.V-M. Bennett. Capt. Woods has not named his co-pilot.

R.A.F. Canberra entries: P.R.7. Racing No. 1, P.R.3. Racing Nos. 2 and 3.—The Royal Air Force Canberra entry consists of three P.R. machines, one P.R.7 and two P.R.3s. The P.R.7 is a new mark with a "stretched" fuselage, powered by two Avon RA7s giving it increased capacity and range. These aircraft, unlike the standard Canberras, carry a crew of only two. To prepare for the race a Canberra Air Race Flight was formed at R.A.F. Wyton under the command of W/C. L. M Hodges, D.S.O. and bar, D.F.C. and bar, who, with his navigator, S/L. R. Currie, A.F.C., will fly the P.R.7. The two P.R.3s will be flown by S/L. L. G. Press, A.F.C. (pilot), F/L. J. W. Harper, D.F.C. (navigator), F/L. R. L. E. Burton, A.F.C. (pilot) and F/L. D. H. Gannon, D.F.C. (navigator). A reserve crew consisting of F/L. R. MacA. Furze (pilot) and F/L. T. E. Dunne (navigator), has also been in training.

Special equipment fitted in the aircraft includes a radio compass, periscopic bubble sextant, Rebecca and extra fuel tanks in the bomb bay. Based on an optimum stage length of 2,700 statute miles, the route chosen is London-Shaibah-Negombo (or Ratmalana), Cocos Islands-Perth-Christchurch. At each staging point an experienced 30-man servicing crew under an Engineer Officer will effect a rapid turn-round in 20 or 30 minutes. A navigation officer at each stop will also prepare flight plans for the next leg.

If the Valiant for some reason falls seriously behind in its schedule during the race, it may well be that these P.R. Canberras will win, their performance being probably slightly superior to those of the Australian entry, which are of the B.2 standard.

The R.A.F. Canberras: Performance of the R.A.F.'s P.R.7 will be watched very closely, since the existence of this type has only very recently been made known. At the beginning of this year a Canberra P.R.3 flown by F/L. Whittington reached Australia from England in an elapsed time of 22 hours, with an average speed for this time of 430 m.p.h. His average ground speed while in flight was about 500 m.p.h. Figures for the P.R.7 should be slightly higher than these.

The Valiant pilots: S/L. Oakley (left) will be co-pilot and F/L. Trubshaw (right) of Vickers-Armstrongs will be captain of the aircraft.

R.A.A.F. Entries. Racing Nos. 4 and 5.—The Royal Australian Air Force has entered two Canberra Mk 20s in the race. These are in fact the first and second aircraft of this type to be built in Australia and correspond to the R.A.F.'s B.2. While practising for the race, some remarkable long distance flights in the Southern Hemisphere have been accomplished. The two aircraft arrived at Lyneham, Wilts, recently and have since been at the English Electric Company airfield at Salmesbury, near Preston. Both aircraft are powered by English-built Rolls-Royce Avon RA3s. Under the command of W/C. D. R. Cuming, A.F.C., who will fly the first Canberra (racing No. 4), the crews consist of the following: F/O. R. J. Atkinson and S/L. C. G. Harvey, second pilot and navigator for W/C. Cuming, and S/L. P. F. Raw, D.F.C., pilot of the second aircraft with F/O. F. N. Davis, D.F.C. and F/L. W. D. Kerr as second pilot and navigator. The route they will follow entails five stages with refuelling stops at Bahrein, Ratmalana (Ceylon), Cocos Islands and Guildford, Western Australia, with an alternative stop at Woomera. At each of these places a navigator will prepare a flight plan for the next leg ready to hand to the pilots as they arrive. Special refuelling facilities have also been arranged at Cocos Islands.

R.A.A.F. Canberra crews: (left to right) W/C. Cuming, S/L. Raw, F/O. Davis, F/L. Kerr, F/O. Atkinson, S/L. Harvey.

R.A.F. Canberra crews: (left to right) W/C. Hodges, S/L. Currie, S/L. Press, F/L. Burton, F/L. Gannon, S/L. Furze, F/L. Dunne. F/L. Harper (2nd crew navigator) is not shown. F/L.s Furze and Dunne are the reserve crew.

The R.A.A.F. Canberras: On previous performance of English B.2 Canberras these machines should average, while cruising, a T.A.S. of approximately 500 m.p.h. These particular aircraft, however, will probably carry extra fuel tanks in the bomb bays and will of course be prepared to give their best performance.

R.A.F. Valiant Entry. Racing No. 10.—The R.A.F.'s Valiant B.1 entry in the race is the least-known quantity and perhaps the darkest horse of all. It will be the first of the new V-class bombers to perform in public in such a way that its true capabilities will to some extent show themselves. The aircraft itself is in fact the second prototype, registered WB 215. Buried in its wing roots will be four Rolls-Royce Avon RA14s which gave some measure of their power in the Avon-Canberra demonstrated at Farnborough last month. The aircraft, which will also carry two large under-wing fuel tanks, has been undergoing preparations for the race at Vickers-Armstrongs' airfield at Weybridge. The crew will consist of the following: chief pilot F/L. E. B. Trubshaw, M.V.O., experimental test pilot, Vickers-Armstrongs; S/L. R. G. W. Oakley, D.S.O., D.F.C., D.F.M., R.A.F. (co-pilot), F/L. W. R. Peasley, D.F.C. (navigator), F. Curtis of Vickers-Armstrongs (flight engineer), G. R. Holland of Vickers-Armstrongs (flight observer).

The route planned for the Valiant consists of only three stages, London-Karachi (4,192 statute miles), Karachi-Cocos Islands (3,255 statute miles) and Cocos Islands-Christchurch (4,929 statute miles), a total distance of 12,376 statute miles. The crew expect to gain considerable data from the flight on such questions as crew feeding during flight, fuel consumption and full-load take-offs in warm climates.

As is the case with the Canberras, servicing crews and navigators have been positioned at each of the Valiant's refuelling points to ensure the quickest possible turn-round.

The Valiant: Security prevents the release of performance figures. However, the design may be considered contemporary with that of Comet 2, and the altitude and cruising speed performances are probably a little better—similar, in fact, to those of the Canberra P.R.7. Its potential range, however, is much greater, being something over 5,000 statute miles. A picture appears on p. 459.

Left: the Mosquito 41, two of which are entered privately. Below: the Canberra P.R.7, one of which is entered by the R.A.F.

HERE AND THERE

RACING NUMBER 10 has been allocated to the Vickers Valiant B.1 (four Rolls-Royce Avon 14s) entered in the Speed Section of the England-New Zealand Race. As seen in this air-to-air view, secured during tests last week-end, massive drop-tanks have been appended to the wings. The machine is the second B.1 prototype, serial-numbered WB215.

I.C.A.O. and M.C.A. Posts

THE Ministry of Civil Aviation announces that Sir Frederick Tymms, K.C.I.E., M.C., will be retiring from the post of United Kingdom representative on the council of the International Civil Aviation Organisation in January, 1954, and will be succeeded by Mr. J. E. Keel, who is at present Under-Secretary (Safety and General), M.C.A. Mr. E. A. Armstrong, C.B., C.B.E., at present Principal Establishment Officer at the M.C.A., will succeed Mr. Keel.

U.S. Bases in Spain

THE agreement between America and Spain for the use of bases in the latter country, announced last week-end, is believed to cover two naval bases and four airfields. It is rumoured that the latter are to be at Barcelona, Madrid, Seville and Albacete. They are considered to be particularly valuable in view of the fact that they are out of range of Russian fighters.

Migs and Money

FOLLOWING an earlier Washington report that the Mig-15 flown over to the Americans in Korea by a Communist pilot would not be returned, a statement made by General Clark on September 24th said: "The traditional policy of the United States of America to grant asylum to those seeking freedom remains unchanged. However, during this period of armistice discussions the offer by the Far East Command on April 27th, 1953, to award $50,000 for undamaged Migs brought to our side is withdrawn. When the rightful ownership of the Mig that recently landed at Kimpo has been established, we will offer to turn it over to that owner." Washington officials indicated later that there was nothing in the statement to suggest that the withdrawal of the cash offer was retrospective; the unnamed Communist pilot will therefore, it seems, receive his $50,000—plus $50,000 for the first such aircraft delivered.

New Avons

NO MORE than the type-tested thrust ratings may be given for two new members of the great family of Rolls-Royce Avon turbojets. The new engines are Avons RA.21 and RA.22 and their ratings are 8,050 and 7,150 lb, respectively.

Anglo-U.S. Woomera Co-operation

WHAT is hailed as the first "active" co-operation between Great Britain and America in atomic-bomb tests will be the use of two Superfortresses in connection with the Woomera tests. They are being used to assist in timing the explosions to avoid the danger of upper winds carrying radio-active products towards populous areas and, secondly, to study the drift of such products—leading, it is hoped, to some profitable deductions in the results of Russian atomic-bomb tests. The first explosion was expected to take place last week-end.

Up and Up

EXPORT of aircraft and parts from Great Britain for the month of August totalled £5,238,933, compared with £3.552,256 in the same month last year. This brings the total for the year to date up to £43,249,262 compared with £28,208,977 for the corresponding period last year.

Australian London Appointment

APPOINTED senior representative of the Australian Departments of Supply and Defence Production—in succession to Mr. J. Hanford Stevens, who recently returned to Australia—is Mr. V. F. Letcher. His office is in Australia House, London, W.C.2.

Another N.Z. Race Withdrawal

AS we go to press, it is learned that another entry has been withdrawn from the New Zealand Race—Rausch Aviation's "Hudstar", illustrated on page 456. This reduces the field to 11.

Flight-safety Presidency

ELECTED president of America's Flight Safety Foundation is Admiral John H. Towers, U.S.N. ret. Admiral Towers, who learned to fly in 1911 and commanded the NC-4 flying boat which made a pioneer Atlantic crossing in 1919, has held many responsible posts in connection with U.S. Naval aviation.

Aluminium Plant Progress

CONSTRUCTION of Norway's biggest aluminium plant at Sunndalsora, West Norway, is ahead of schedule, and it is expected that production can start next year. Output will be 40,000 tons a year at first, but may be increased to 50,000 tons later. Overall Norwegian production of aluminium is now about 50,000 tons a year, so the new works will almost double the national output. The plant is being built with the help of a U.S.A. loan and, under the terms of the loan, repayment will be made in the form of aluminium at the rate of about 8,000 tons a year.

IN LONDON: Visitors to London Airport last Saturday were Sir Hudson Fysh, chairman of Qantas Empire Airways, and the Britannia in which he took a trial flight. A letter of intent regarding an order for six Britannias (probably Mk 250 passenger freighters) has already been sent to the Bristol company. After his 45-minute flight, Sir Hudson commented on the silence and stability of the Britannia. In our picture are (left to right) Captain Allen, deputy general manager of Qantas; Mr. Uwins, Bristol director; Sir Hudson Fysh; and Mr. Russell, designer of the Britannia.

B-57s START TO FLOW

The first two B57As. The lynx-eyed will notice that the British-built Canberra (left), used as an installations test-bed, mounts two underwing pods (fuel or rockets?) and two HVAR missiles farther outboard.

LAST week we heard first-hand news of Martin's progress with the production of their B-57 Canberras and of the official handing-over ceremony of the first machine for the U.S. Air Force. The information came (together with a colour film to support it) from Mr. Jess W. Sweetser, vice-president, sales, and Mr. J. Bolles, chief of the sales department, of Glenn L. Martin, during their recent visit to Europe. A DC-6, lately of the President's fleet, was used to transport a remarkable body of "top brass" from Washington to Martin's airfield, a distance of fully 35 miles, to witness the Canberra demonstration and the dusk handing-over ceremony on August 20th—the time of day being symbolic of the Canberra's night intruder role.

Among the American senior officers and other officials present were Gen. Twining, Chief of Staff, U.S.A.F.; Lt.-Gen. Putt, Air Research and Development Command; and Lt.-Gen. Rawlings, Air Materiel Command. They were received by Mr. George M. Bunker, president of the Martin Company, and Mr. O. E. Tibbs, Martin flight test manager (whose appearance brings to mind Mutt Summers, until lately Vickers chief test pilot).

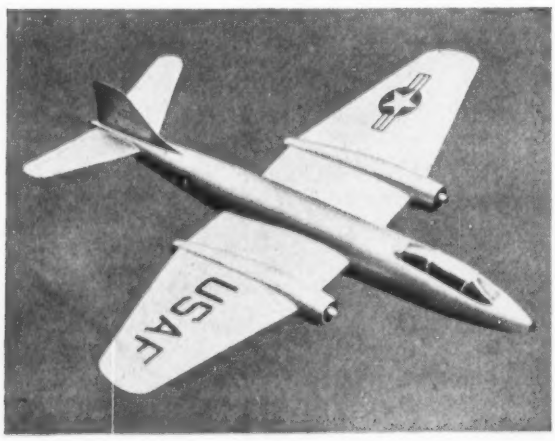
Mr. Sweetser said of Martin and English Electric relations that there was splendid and continuing co-operation. There were now three B-57As flying, and all had come up fully to expectations. The American version looked very much the same as the British one, and the J65 Sapphires, of which the Buick company were building the first 100 or so, were coming along well. Later, Wrights, the prime licensee, would be producing the engines.

In keeping with the U.S. policy of the time to spread production, about half of the B-57 airframe had been sub-contracted. It was Mr. Sweetser's belief that B-57A squadrons of the U.S.A.F. in America would be operating by the end of this year, and he added that other squadrons in Europe wanted the aircraft badly and would probably start to get them early next year. The first-formed squadrons, equipped with B-57As, would have reconnaissance and light-bomber duties, but after this initial batch B-57Bs—the night intruder version—would follow. The Canberra had originally been selected for production by Martin after a search of the products of all countries. Roland Beamont, English Electric chief test pilot, and his team, are at present in America for consultation now that there are some American-built B-57s to fly.

Both the American visitors apparently felt strongly about the waste involved as a result of the need completely to re-engineer the Canberra down to the smallest parts simply to conform with American standards. Mr. Sweetser said that the two countries must move towards the aim of common standards.

To his colleague's comments Mr. Bolles added that the Canberra was probably the most versatile aircraft that his people had seen. At low level the machine, flying at 180 kt and only 200 to 300ft high, could turn within a 5,000ft circle. The American version of the machine had been engineered to make almost everything interchangeable. His company had been led to think that they used a great deal more jigs and tools than the British manufacturers, but at the English Electric factory at Preston, with one or two minor exceptions, there was as much tooling as in the American plant. He felt, however, that this was not necessarily representative of the British industry as a whole. Martin's had had very few tooling or production problems, and of the sub-contracted surfaces the tail units had come through well, but there had been a hold-up because of failure to supply wings. Martins were taking back this work to their own factory.

As long ago as last February 13th we published this photograph of a B-57B model. It shows well the revised cockpit and longer nose.



Talking of the difference between the B-57A and B, Mr. Bolles said that the A was practically a carbon copy of the English machine, but the B would have the American-style two-seat tandem cockpit ("with no black hole at the back") and also differences in armament and navigational equipment. It would be approximately 4,000 lb heavier when fully equipped, but the power/thrust ratio would still be better than the standard British B.2 because of the fitting of the 7,200 lb J65 Sapphires. The U.S. Chief of Air Staff had endorsed the high opinion officially held of the B-57; Mr. Bolles had no doubt that the crews in the future "could not help but like it."

Martins have equipped their B-57s with rotary bomb-doors upon which the bombs or rockets are mounted (*Flight*, August 14th last, p. 188), which completely eliminate turbulence that results from the opening of conventional bomb doors at high speeds. This was felt to be a great improvement. A tail parachute had been considered, but this was not now being proceeded with because the aircraft was normally landing and taking off in 2,500ft. It was Martin's belief that there was a good chance of follow-on orders being placed for B-57s, and according to present plans all American-produced machines would go to the American forces and none to other NATO countries.

In the colour film shown of the August 20th ceremony and demonstration, the starting-up of the Sapphires involved enormous clouds of black smoke which was somewhat disconcerting until it was explained that in America smokeless powder is not yet available for the cartridges. A very nice compliment was paid to Beamont when it was stated that of all the impressive demonstrations which have been given by Canberras in America, none has equalled the one which the English Electric test pilot gave on his first visit to Baltimore.

NEW N.P.L. AERODYNAMICS CHIEF

THE Department of Scientific and Industrial Research announced recently that Dr. W. P. Jones had been appointed superintendent of the aerodynamics division of the National Physical Laboratory, in succession to Mr. Arthur Fage, C.B.E., F.R.S., F.R.Ae.S., F.I.A.S., who retired from the post earlier this year.

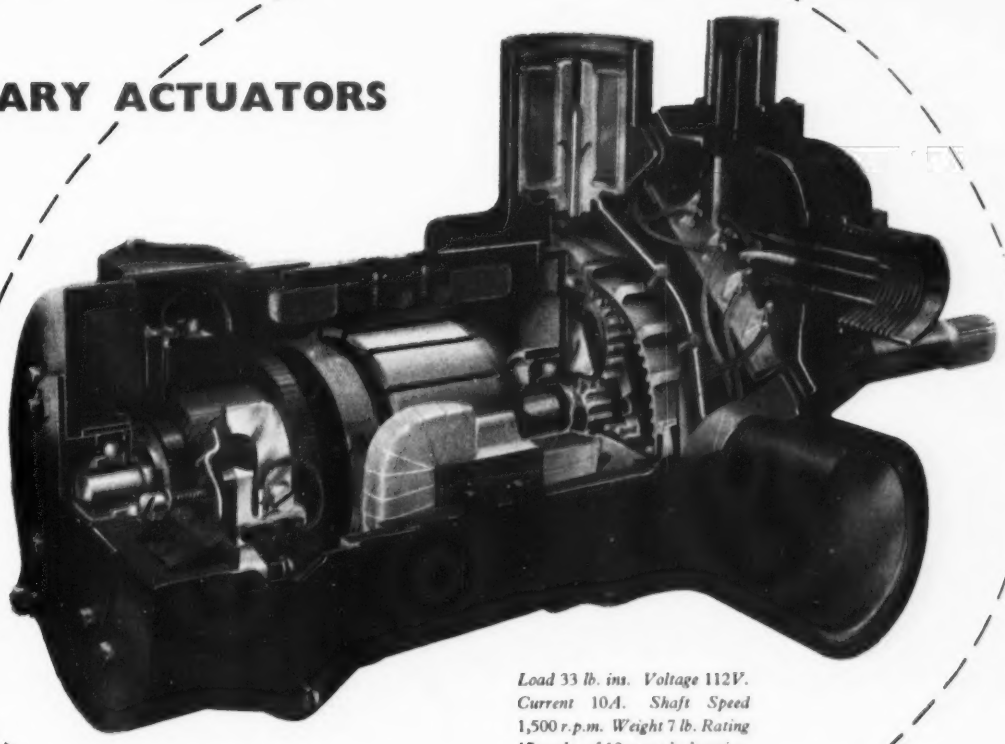
Dr. Jones was educated at Lampeter and Oxford and graduated with first class honours in mathematics. After reading physics for two years he joined the N.P.L. in 1935. He is a leading authority on oscillations and flutter and in recent years has been in charge of work concerned with such phenomena.

Mr. Arthur Fage is one of the pioneers of aeronautical research. He retires after no fewer than 41 years of service in the N.P.L. aeronautics division, which he joined after studying at the Royal College of Science. During World War I he was concerned with such problems as those of pressures over airship envelopes, the tearing of balloon fabrics and the characteristics of aerofoils. In 1920 he began his extensive research into boundary layers and turbulent flow. He became an authority on his subject, many of his findings being published by the Royal Society, of which he became a Fellow in 1943.

From his appointment as superintendent of the aerodynamics division in 1946 to his retirement he concerned himself with the improvement of wind tunnel equipment and the planning of the new high-speed laboratory at Teddington.

He has served on many of the committees and sub-committees of the Aeronautical Research Council and he was appointed C.B.E. in the Coronation Honours List in recognition of his services to aeronautics.

ROTARY ACTUATORS



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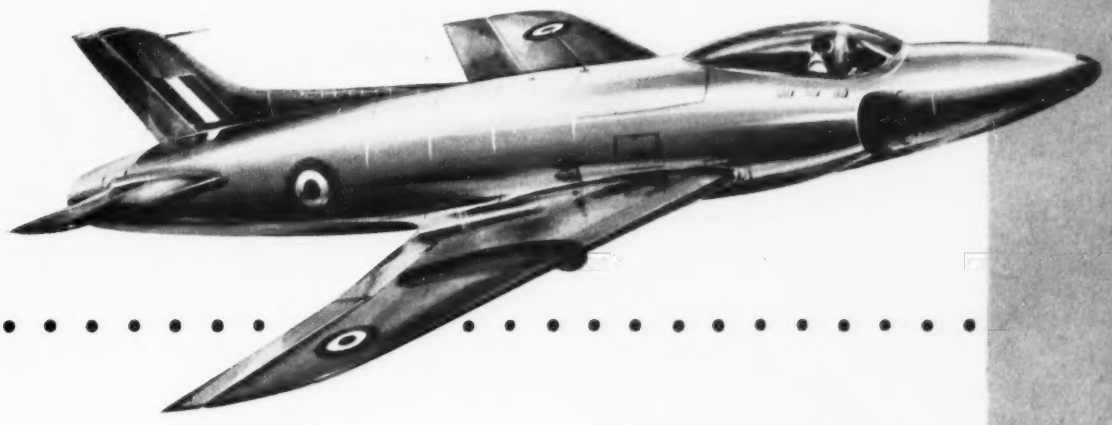
Supermarine

40th anniversary

PROGRESS REPORT

ONLY ten years after powered flight became a reality, Supermarine began the developments that have contributed so much to aviation progress. Fighters in the first world war, the series of Schneider Trophy seaplanes, the 'Southampton' flying boats, the famous 'Spitfire' and its successors today, the 'Attacker', the supersonic 'Swift', and the new naval twin jet . . . these are some of the achievements that reflect above all the imagination, persistence and skill that have always typified Supermarine activities. In the future as in the past British air power will owe much to Supermarine.



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(*With a contribution by Jeffrey Quill, O.B.E., A.F.C.*)

SIRES OF THE SWIFT

A FORTY-YEAR RECORD OF SUPERMARINE ACHIEVEMENT

Part 1. The Pattern of Progress

A MAN who helped to keep things lively in the early days of British flying (indeed, throughout his career) was Noel Pemberton Billing, and when he died in 1948 he was remembered and respected for a wide variety of ideas and achievements. We are concerned with him here as the founder of the great Supermarine organization, whose fortieth birthday is honoured this year.

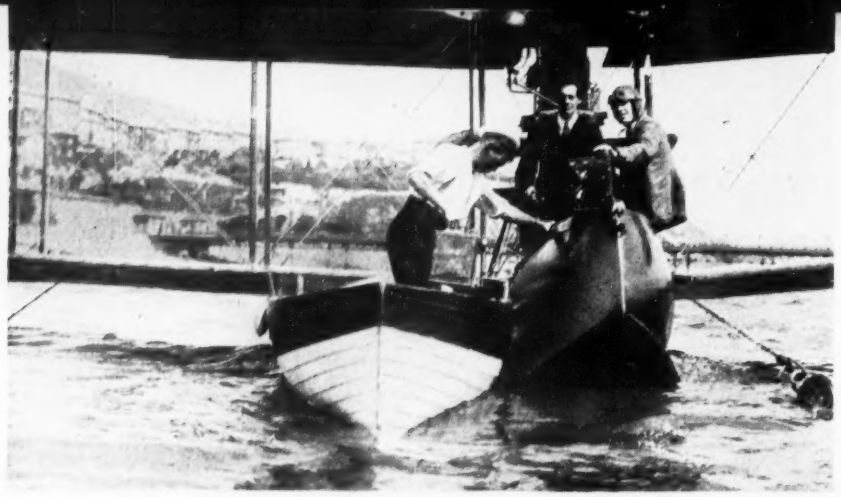
P.B.'s enthusiasm for aeronautics dated from the early 1900s, and in 1912, while he was dwelling aboard a three-masted schooner moored in the Itchen, he took over premises at Woolston for the construction of aircraft—especially those of the marine persuasion.

One of P.B.'s resolutions being to build "a boat that will fly rather than an aeroplane that will float," he registered the name Supermarine as his telegraphic address, and the remarkable tractor flying-boat which he exhibited at Olympia in March 1914 was styled Supermarine P.B.1. It was acclaimed as one of the cleanest aircraft, irrespective of class, constructed up to that time and the workmanship was exquisite. The circular-section hull had steps built on as separate units.

June 1914 saw the business transformed into a limited company—Pemberton Billing, Ltd.—with an initial nominal share capital of £20,000. The two subscribers were P.B. himself and Alfred de Broughton, and hardly had the business been reconstituted under their directorship when Britain went to war. Thus, *Flight* of August 14th, 1914:—

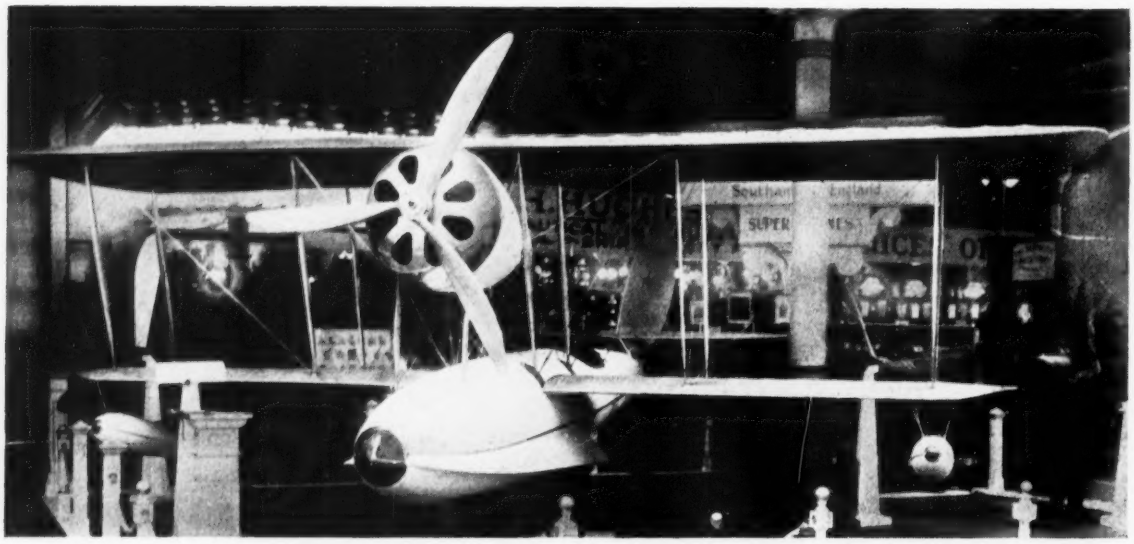
"'Hustle' is the order of the day at the Supermarine works at Southampton just now, and the latest product is a small scouting biplane. In his breezy way Mr. Pemberton Billing has given the timetable of the progress of the first P.B.9, as these machines are to be known. The decision to turn out the scout was not come to until Monday, when the draughtsmen attacked the problem of forthwith getting out the designs. To such effect did they work, that by Tuesday actual construction was commenced, and by the following Tuesday the machine was ready to take the air."

A full description of the little scout appeared in the following issue, so that something of a record for aeronautical journalism, as well as for aircraft construction (and perhaps for security laxness also), seems to have been established. Which leads us to reflect that, in present circumstances, a full description of Supermarine's latest fighter, the Swift, or of its Rolls-Royce turbojet, is unlikely to be authorized for many months, or even years, to come.



Refueller alongside a Channel flying-boat. Petrol was handled in two-gallon cans.

(Below) Pemberton Billing P.B.1 photographed by "Flight" at Olympia in 1914.



SIRES OF THE SWIFT . . .

To Mr. R. H. Bound, F.R.Ae.S., M.I.Mech.E., A.M.I.A.E., who assisted Pemberton Billing, and is now technical director of Dowty Equipment, Ltd., we are indebted for the following note on another of P.B.'s projects: "A very interesting type of aircraft," he writes, "was a flying-boat specifically designed to overcome the destruction which might result if it were forced into the sea. P.B. realized that under those conditions it was essential to discard the wings. His flying-boat was very ingenious; the hull was shaped like an ordinary speed motorboat with a sloping deck down to the stern. The engine was mounted in the hull, and the biplane wings, which carried tail booms supporting the tailplane, fins and rudder, could be discarded in a few seconds by undoing two breech blocks, thus allowing all the superstructure to slide off backwards into the sea. This superstructure carried the mounting for the propeller, which was chain driven from the engine in the hull. Unfortunately, the two boats of this type under construction were never completed owing to the exigencies of the war (I believe they were on order from Germany). However, the hulls saw a great deal of service afterwards as speedboat tenders for subsequent flying-boats used on Southampton Water." Mr. Bound also recalls that the "Seven-Day Bus" which he believes was the result of a bet between Pemberton Billing and Gordon Bell, was towed through the streets and used by P.B. as an electioneering platform when he decided to stand for Parliament.

Hubert Scott-Paine, who was to remain a guiding power in the Supermarine organization until 1923, was appointed manager on December 10th, 1914. The following year saw a new fighting scout, dubbed "Push Proj.," or Pusher Projectile (its streamlined nacelle being of circular section), in the air. But, like the "Seven-Day Bus" before it, this effort came to nought, though it did have the somewhat academic distinction of being one of the earliest fighters with swept-back wings. The engine was a Mono-Gnome.

The accessibility of the Supermarine works from the Continent was a factor which caused them to be used, during a considerable period of the war, for the repair and maintenance of aircraft from France. They were engaged, too, on the construction of some fifty Norman Thompson flying-boat trainers for the Admiralty and for a time were sub-contracting on the famous Short 184, or "225," floatplane.

In 1915 Pemberton Billing was granted indefinite leave from the R.N.A.S. (which he had joined soon after war began) to design a mighty "Zeppelin killer." This materialized as the phenomenal Night Hawk quadruplane—cannon-armed, searchlight-equipped, and supposedly capable of hovering in a 28-m.p.h. breeze to lie in wait for its prey. It was never to see service, though it is commended to the student of military-aircraft design as an object-lesson in precocity. The Night Hawk was tested in 1916, and in the same year a youth named Mitchell—R. J. Mitchell—joined the company. It was in 1916, too, that Pemberton Billing sold his interest, whereupon the name of the company was changed to The Supermarine Aviation Works, Ltd.

Thereafter the factory came under Government control and the twin-float Navyplane and A.D. flying-boat were constructed to Admiralty designs. Both were of uncommon interest, yet hardly as noteworthy as a third officially-sponsored machine known as the Baby, or by its specification number, N.1B. To this compact little scout the Schneider victors and fighters of later years owed a heavy debt.

The war was not long over when Scott-Paine was joined by Sqn.-Cdr. James Bird, who, like himself, was a lively protagonist of the flying-boat. To stimulate interest the co-directors sent a Channel-type boat, with 160-h.p. Beardmore engine and open seats for three passengers, on a propaganda-*cum*-joy-riding campaign along the south coast. Experimental services from Southampton to Le Havre and the Channel Islands were run with the same type of machine, but base rumour had it that, in all but ideal conditions, the take-off performance was such that it was often simpler to taxi. A Mk II Channel was later developed and had the 240-h.p. Siddeley Puma and a re-designed front

step. It lived down the scurrilous stories concerning its predecessor's reluctance to leave the water by rendering valuable service in many parts of the world.

The year 1919 saw Supermarine's first participation in the Schneider Trophy Race, with which they were to be closely and victoriously associated over a period of several years. Their entry was the Sea Lion I, a little pusher boat capable of 149 m.p.h. and developed from the Baby. The engine was a "broad arrow" Napier Lion, then embarking on its own splendid career in military, civil and sporting flying. As the old-timers will remember, the race took place at Bournemouth, and proved a complete fiasco. Only the Italian pilot Janello completed the course, and even he was disqualified as the judges had not observed him at the Swanage turn. The acrimony which ensued left a slightly unpleasant taste in everybody's mouth. To make things worse, the Sea Lion had been damaged by an obstacle while taking off after a precautionary alighting in mist. The pilot was Sqn.-Cdr. Basil Hobbs, and Capt. John Hoare was the engine-starter. In this capacity he was responsible for setting the Lion roaring and then taking a header.

At the Olympia Show of 1920 (during which year Mitchell was appointed chief engineer and designer) Supermarines showed not only a Channel boat, but a new amphibian fighter called the Sea King I, powered with a 160-h.p. Beardmore. In that year also they entered an Eagle-powered commercial amphibian for an Air Ministry competition at Martlesham Heath and Felixstowe. The winner proved to be a Vickers Viking, but the Supermarine machine was placed second and was awarded a prize (specially increased in recognition of its peculiar merits) of £8,000. Witnesses of the trials recall how, as soon as the wheels touched the ground, the tail would come up and the bows would slide along the ground, exerting a useful braking effect.

On the military side, in 1920-21, the company evolved the Seal deck-landing amphibian fleet spotter. This was notably more efficient than the Competition amphibian, which, having been designed and built in a few weeks, was somewhat handicapped by unnecessary weight. A developed version of the Seal, re-named Seagull, was put into production during 1922 for the Air Ministry and was successfully operated from aircraft-carriers and shore bases. Like its predecessors, it was of wooden construction.

A resounding Schneider success at Naples crowned the same year. The races of '20 and '21, it should be mentioned, had both degenerated into fly-overs for the Italians, and a third win would mean that the trophy would become Italy's permanent possession—as it is now our own. In the absence of Government backing, therefore, Mr. Scott-Paine and Cdr. Bird decided to finance a private venture. This materialized as the Sea Lion II, a development of the 1919 Sea Lion I, cleaned up under the direction of Mr. Mitchell and flown by the redoubtable Supermarine chief test pilot Henri Biard.

This time the race was no fiasco. The Sea Lion was off first, and when the Italians compared Biard's time for his first lap with that of their own machines they were a trifle saddened. What they did not know was that the little Supermarine had never been opened up to its full speed on the trials they had witnessed and that Biard had deliberately turned in a clumsy fashion on his practice runs. The betting, of course, was heavily against him.

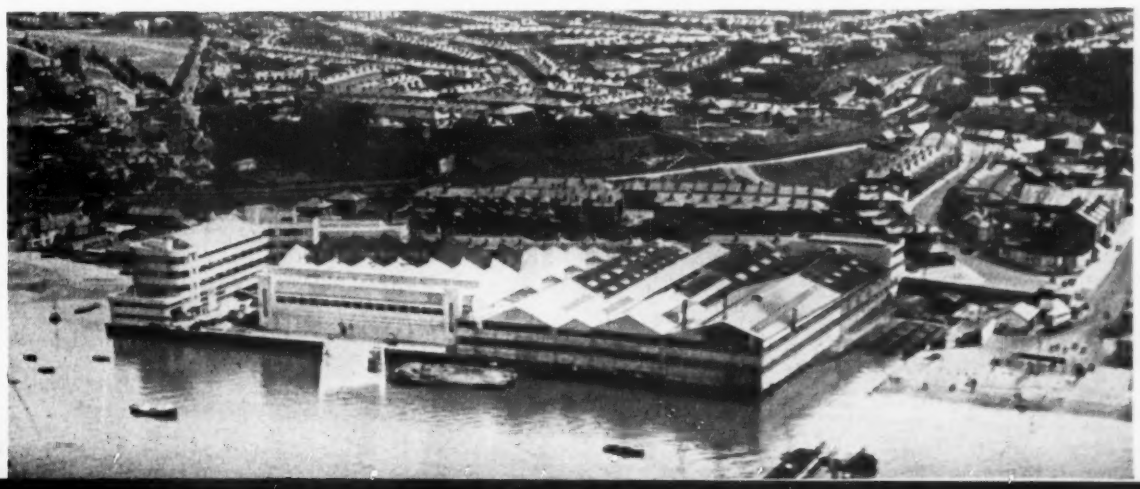
Biard's lap-time actually worked out at over 160 m.p.h.—an astonishing figure—and he maintained it for six laps, easily overhauling two of the Italians in the meantime. Then he throttled the Lion back a little and, as his speed slackened, the faster of the Italians began to reduce his lead; still he was lapping in over 20 seconds better time than the best of his rivals. Came the thirteenth lap and Biard opened up again to full bore, to win by 2 min 3 sec, at an average speed of 145.7 m.p.h. for the distance of 200.2 miles.

When Mr. Scott-Paine and Capt. Biard returned to Southampton a few days later they were accorded a civic reception, and *Flight's* report avers that "remarkable scenes" were later witnessed at the Supermarine works. That we may believe, for the works were noted for the friendly relationships of management and staff.

The next Schneider contest—flown at Cowes in 1923—was a palpable defeat for Supermarine and for Britain; but it was also a salutary lesson, and one which was put to good account. For this race the Sea Lion was brought out once again, now in its third form, with clipped wings, more cleanly cowled engine and modifications to the hull. Originally there were ten entries—three British (with Biard again on the Sea Lion), four French and three American, the latter sponsored by the U.S. Navy. A succession of mishaps, however, reduced the field to the Sea Lion, a C.A.M.S. 38 and two Curtiss C.R.3 Navy Racers.

Biard put up his usual fine show but the Sea Lion was no

Supermarine's Woolston works in 1919/1920 and in 1937. A distinct "tidying up" had taken place during the interviewing years.



Two great men—R. J. Mitchell (left) and Sir Henry Royce.

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match for the very clean, twin-float Curtiss seaplanes, with the new, compact, D.12 engine of the same manufacture. Lt. David Rittenhouse, U.S.N., won easily at 177.38 m.p.h.

It is recorded that Biard finished the race in a zoom climb to several thousand feet, and that zoom may be considered to have carried the classic type of pusher biplane boat clean out of the Schneider picture. At an official banquet after the race Mr. Scott-Paine admitted that the Sea Lion had lost to better machines and men, and apologized to Capt. Biard for not having given him a good enough mount.

No one was less surprised by the result than Mitchell; but while he frankly admitted that the Curtisses had provided some valuable design wrinkles, he pointed out that they were still biplanes. His own dream racer was a monoplane—and a cantilever at that.

The Schneider Trophy contests were eagerly awaited diversions from ordinary business, which was progressing sufficiently well for Messrs. Scott-Paine and Bird to form the British Marine Air Navigation Co., Ltd. The purpose of this company was to operate flying-boat services between Southampton and such places as Cherbourg and the Channel Islands, and the intended aircraft, the first of which was tested in the summer of 1923, was the Sea Eagle. Three Sea Eagles were eventually put into operation and they were well liked by passengers, six of whom were accommodated in the forward cabin, while the pilot sat aft and above. The engine was a Rolls-Royce Eagle IX of 360 h.p. When the newly-formed company was amalgamated in 1924 with Handley Page Transport, Instone Airline and Daimler Airways, to form Imperial Airways, the Sea Eagles continued in service. A related type, developed for military purposes, was the Scarab amphibian bomber, twelve of which were supplied to Spain. They were used in the Moroccan war. Far larger than the Scarab, though on somewhat similar lines, was the twin-engined amphibian built in 1924 and known as the Swan. In an incomplete state this—the largest amphibian built up to that time—was Supermarine's showpiece when the Woolston works were visited by H.R.H. the Prince of Wales. This honour he had not conferred on any other aircraft factory since 1918.

Ordered by the Air Ministry as a passenger carrier the Swan was not initially fitted for the work, and Felixstowe trials proved so satisfactory that the Air Ministry decided that a modified version would make a suitable replacement for the old F.5. Thus from the Swan was evolved Supermarine's flying boat masterpiece, the Southampton, a type of which we shall have much more to say. But first we must place on record the almost forgotten fact that for the 1924 Light Aeroplane Contests at Lympne a dainty little sesquiplane called the Sparrow was built by Supermarine round a three-cylinder Blackburne engine. In 1926 it turned up at Lympne again—this time as a parasol monoplane.

Truly, it seemed, Mitchell could design any sort of machine required of him.

His "hush-hush" Schneider Racer of 1925 was the S.4, and it was a cantilever monoplane, as he had foreseen. The mid-position wing was faired with the outer cylinder blocks of the 700 h.p. Lion and twin floats were mounted on carefully faired cantilever struts. Construction was of wood, but a modern touch was the fitting of trailing-edge flaps interconnected with "drooping" ailerons.

The S.4 was built as part of an Air Ministry programme of high-speed development and was loaned to the builders for entry in the 1925 Schneider race. "Instructions to proceed" were issued on March 18th of that year and the machine first flew on August 25th. On September 13th Henri Biard put it over a 3-km straight course at Calshot at the world record speed of 226.752 m.p.h. Following this achievement Napiers increased the engine power and a more efficient airscrew was fitted in preparation for the race, to be flown near Baltimore.

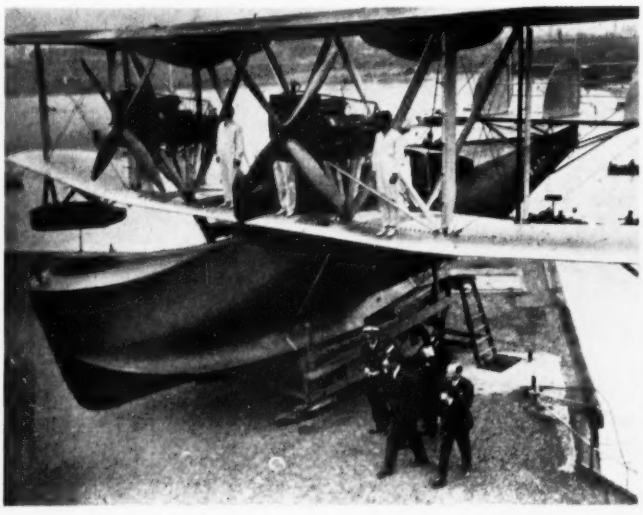
But when the British team sailed for America ill-luck went with them. First, Biard slipped on the deck of the liner and seriously injured his wrist. Then, on arrival he went down with 'flu and, while recovering, was brought the news that the tent housing the S.4 had blown down in a gale and that a tent pole had fallen across the tail. Mitchell was on the spot, however, and it was possible to effect repairs. Biard soon had the racer in the air, and when, at about 800ft, he was seen to make a steep turn, the machine behaved in such a manner that spectators thought that he was "stunting." The appalling fact was, however, that the S.4 was in grave difficulty with wing flutter, concerning which very little was known at the time. Somehow Biard managed to flatten out just before touching the water, but the floats struck hard, the undercarriage collapsed and the S.4 went under. By astonishing luck (at last) the fuselage broke at the cockpit and Biard escaped with his life.

From this ill-starred, but courageously designed, racer we turn again to the Southampton—a flying boat of uncommon character, all of it good. Who would disagree that, despite the maze of interplane struts, despite the gap between the wings and the hull (for the complete wing cellule, with two Lion engines, was lowered bodily on to the pick-up points) the "Soton" had a queenly grace hardly surpassed by any later craft of its class.

The prototype was a wooden-hulled machine, as were the first production machines, and it was designed, built, tested and delivered in 7½ months. Felixstowe and Calshot enthused about its handling qualities in the air and on the water, and visitors to the Woolston hull shop who were privileged to see the new boats under construction were charmed by the workmanship. One of them writes that he will never forget "the pleasure of watching these wooden hulls being made, the thrill of running one's fingers over the smooth surface and the scent of the wood planks, fitted together with such loving care by the real craftsmen whom Scott-Paine employed."

Coastal Area of the R.A.F. lost no time in trying out its first Southamptons under operational conditions. Wishing to dis-

His Royal Highness the Prince of Wales inspects the Swan.



(Below) The Sea King II fighter (left) and Seal fleet spotter.

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de Havilland Heron	de Havilland Gipsy Queen 30	800 hours
de Havilland Dove	de Havilland Gipsy Queen 70	800 hours
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— and still advancing

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cover whether the boats could accompany a fleet to sea and be refuelled by Naval craft, they despatched four of them on a 10,000-mile cruise in the Irish Sea during September, 1925. This not only proved that they could look after themselves while working with the Navy, but that they could be relied upon to operate in foul weather. Meanwhile a metal-hulled version of the Southampton—the Mk II—was being designed by Mitchell and his staff.

The single-engined Seagull was still in demand, and six were delivered to the Royal Australian Air Force during 1926. They equipped a special flight, which had been formed for the photographic survey of the Great Barrier Reef, and their amphibious qualities were, of course, of immense value.

In July, 1926, a pair of Southamptons flew from Plymouth to Egypt, Cyprus and back; but this was a small undertaking compared with that of the historic Far East Flight of four Southampton IIs, commanded by G/C. T. R. Cave-Brown-Cave. Their historic voyage began from Plymouth Harbour on October 17th, 1927, with the four gleaming white boats in formation. First they flew across France and Italy to Athens, then headed south to Aboukir. Thereafter they alighted at the Syrian port of Alexandretta, before striking inland over the desert to the Euphrates; and thence they droned on at their 70-80 knots to Basra, and down the Persian Gulf to Karachi. Their ensuing journey round the coast of the Indian Peninsula blazed a new air trail, and the crews took note of the suitability of the harbours for flying-boat work. Though even at that date the next long stage—from Calcutta through the East Indies—was comparatively well known, the coast of Australia had only once been circumnavigated by a seaplane. First the four boats headed down the west coast, and at length, after circling the entire continent, returned to Singapore. It was not long before they were on their way north to Hong Kong; but eventually their wanderings brought them back to Singapore, and there they took up station.

"So far as dangers were concerned," runs a contemporary account, "the cruise was as prosaic as that of a P. and O. steamer plying between Tilbury and Bombay." The Southamptons, it is noted, were plagued by barnacles which collected on the hulls in some harbours; by tar oozing from fuel lighters and fouling their white hulls; and once by a faulty Primus stove. One or two of the crews had slight attacks of fever, and when the men had to clean hulls below the water-line they suffered temporarily from earache. But of real troubles there were none.

For identification, incidentally, the hulls were painted with black stripes, and these were the means of discovering a curious phenomenon: whereas barnacles would attach themselves to the stripes, they left the white paintwork severely alone.

The Far East cruise was followed during the same year by others of high merit and the Royal Australian Air Force was sufficiently impressed to acquire two wooden-hulled Southamptons.

It was in 1927, too, that the Schneider success, for which Mitchell had striven in designing the ill-fated S.4, came to pass. His new racer, the S.5, was of somewhat similar appearance, though it had a low-mounted, wire-braced wing, and the cockpit was placed further forward. To balance airscrew torque all the fuel was carried in one float.

Three S.5s were built for the Air Ministry's high-speed development programme and two of them represented Great Britain in the Schneider race at Venice on September 26th, 1927. The pilots were F/L. O. E. Worsley and F/L. S. N. Webster. Webster's machine had a geared Lion, while the Lion in Worsley's mount drove the airscrew direct. Of the two, Webster's was the faster, and he won at a speed of 281.65 m.p.h., exceeding the world's record for landplanes by 3 m.p.h. During the race he had, incidentally, set up a record over 100 km of 283.66 m.p.h. Worsley was second at 273.07 m.p.h.

Our Italian hosts paid handsome tribute to the victorious team. Thus Prince Scalea, President of the Aero Club of Italy: "The Venetian sky has seen many noble sights and valorous deeds in the past, and it is indeed fit that in this same Venetian sky English pilots should have won a victory which has stirred the imagination of the whole world."

The two S.5s were later used by the High Speed Section of the Marine Aircraft Experimental Establishment at Felixstowe, and on one of these, during November, 1928, F/L. d'Arcy Greig set up a new British speed record of 319.57 m.p.h. But though he had probably flown faster than any human being before him, he had failed to beat the standing record of Colonel the Marquis de Bernardi by the required 8 km/hr.

The period 1927/28 saw important changes within the Supermarine organization. In 1927 (by which time Mr. Scott-Paine had resigned to become a director of Imperial Airways) Cdr. Bird turned the firm into a public company, and in the following year the great Vickers group, through their subsidiary, Vickers (Aviation), Ltd., acquired the entire share capital. A condition of purchase was that R. J. Mitchell was to be bound to the company without option of terminating his agreement before December 5th, 1933. At the time of the take-over there were approximately 750 employees.

Throughout 1928 the Southampton continued in production, not for the R.A.F. alone, but for Japan and Argentina also. As a torpedo-carrier for the Danish Navy a three-engined development, called the Nanok, and having a redesigned wing cellule, was put in hand. The engines were Siddeley Jaguars and one torpedo was carried under each lower wing. As things transpired, the machine was never taken over by the Danes, and it was afterwards converted into a civil air yacht and sold to the Hon. A. E. Guinness. In its civil form it was known as the Solent.

A new type of three-seater military amphibian, powered by two Armstrong Siddeley Lynx engines and resembling a miniature Southampton, was turned out in 1929, but the year was chiefly notable for the introduction of a new type of Schneider racer, the S.6. Two examples were ordered and each was powered by one of the magnificent new Rolls-Royce R-type racing engines. The airframes bore a general resemblance to the S.5 but incorporated several innovations, including radiators in the floats as well as in the wings.

The race of 1929 resolved itself into an Anglo-Italian duel at Spithead. The S.6 pilots were F/O. H. R. D. Waghorn and F/O. R. L. R. Atcherley, and it was Waghorn who proved victorious at an average speed of 328.63 m.p.h. Atcherley was disqualified for missing a turning point, but he completed the course and, incidentally, set up world's records over the 50 km and 100 km distances at 332.49 m.p.h. and 331.75 m.p.h. Only a few days after the race S/L. A. H. Orlebar, A.F.C., flying the winning S.6, raised the world's speed record first to 336.3 and later to 357.7 m.p.h.

Thus did the record-breaking, war-winning, world beating partnership of Supermarine and Rolls-Royce have its true beginning, though, as we have seen, certain of the early Supermarine flying-boats were powered by the famous Eagle.

For the Southampton Mk X prototype flying-boat of 1930 three Armstrong Siddeley Panthers (and later three Bristol Jupiters) were chosen. Retention of the name Southampton was misleading, for this boat was of entirely new design, having a sesquiplane superstructure and a flat-sided hull, to facilitate production in metal. The under-water portion of the hull was planked with stainless steel. Even less conventional was the three-Jaguar parasol monoplane Air Yacht, likewise tested in 1930, and acquired, as was the earlier Solent, by the Hon. A. E. Guinness.

Inside the Swan amphibian—largest of its kind.

Hitherto we have made no reference to the many remarkable designs which never materialized, though, did space permit, a great deal could be written concerning these. Among documents and photographs, formerly the property of Cdr. Bird, and kindly placed at the writer's disposal by his son, Mr. J. S. Bird, we find, for example, designs for a triplane flying boat powered with Rolls-Royce Condors and designed for operation as a torpedo carrier. A feature of this craft was to have been a water propeller. Another projected type, called the Sea Hawk, was a civil development of the Southampton Mk X; but most significant of all, perhaps, was the great six-engined flying boat, somewhat resembling the Dornier Do X and designed in 1930. This was

The four Southamptons of the Far East Flight at Singapore. These were metal-hulled machines with Napier Lions.

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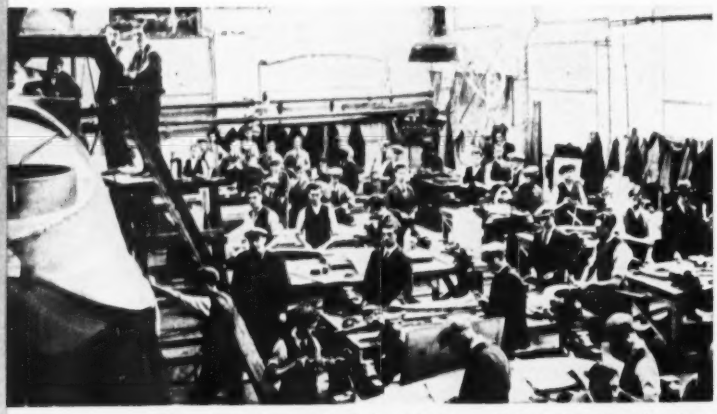
to have six 900 h.p. Rolls-Royce Buzzard engines and to carry forty passengers. Construction was already under way when the order was cancelled by the Government in a spasm of economy. A Condor-engined single-seater designed in the 1920s was called the Sea Urchin.

The Schneider victories of Webster and Waghorn in 1927 and 1929 meant that Britain had only to win the race of 1931 for the trophy to remain in her permanent possession; but in the absence of a Government subsidy the prospect seemed hopeless. Suddenly the late Lady Houston made her magnificent offer of £100,000 to finance a British team. Only about six months remained before the race, but Supermarines set to and built two S.6 developments, known as S.6Bs. At the same time they modified the original S.6s to S.6As—these to be kept as reserves.



(Above) Southampton hull-shop, Woolston. (Below) The finished product, with another fine piece of engineering.

The S.6Bs carried more fuel and oil than the original type and the floats were redesigned and enlarged. Dimensions were, in fact, slightly increased all round and various parts of the structure were stiffened. The engine was a Rolls-Royce R of greater output than formerly.

As it happened, the Italians were not able to prepare their defending racers in time and F/L. J. N. Boothman (now Air Marshal Sir John Boothman, Controller of Supplies (Air)), won the trophy outright in a fly-over in an S.6B at 340.08 m.p.h. On the same day the second "B", flown by F/L. G. H. Stainforth, put up a world's speed record of 379.05 m.p.h.; whereupon Rolls Royce proceeded to excel themselves by producing a "sprint" engine developing 2,600 h.p. With this installed in a 6B George Stainforth straightway set up a new world's speed record of 407.5 m.p.h., in the course of which he became the first man to fly at over 400 m.p.h.

The Schneider Trophy now rests in the Royal Aero Club—a permanent reminder of the great days when the fastest machines in the world were pitted against each other under the most exciting and picturesque circumstances.

It was not to be expected that Supermarine's unbeatable partnership with Rolls-Royce would be confined to the racing field, and in 1931 two standard Southamptons were adapted to take two steam-cooled Kestrels in place of their Lions, with a notable improvement in performance. These boats provided valuable experience for the design of a Southampton replacement, which, though known as the Southampton Mk IV, was, in fact, totally new. When the first photograph appeared in *Flight* in February, 1933, it was seen that the wing cellule had been very much cleaned up, the hull redesigned, the pilots' cockpit enclosed, and the twin Kestrels attached beneath the top planes. Under the name Scapa the new boat was adopted by the R.A.F. and proved a wholly worthy successor to the Southampton II.

Just as the so-called Southampton IV was only distantly related to the original Southampton design, so the metal-constructed Seagull V single-engined amphibian, first flown in 1933, was a very different machine from the wooden Seagulls of earlier years. It was, nevertheless, intended for similar duties, and there was no surprise when it was learned that the first batch was for Australia. Though the designation Seagull V was retained for the Australian machines, a similar aircraft, when adopted for service with the R.A.F., was renamed Walrus.

Although, as we have intimated, the Scapa was a very fine craft indeed, it was on the small side for Service requirements, and towards the end of 1934 an enlarged development, along somewhat similar lines and designated Southampton Mk V, was launched. The engines were two Bristol Pegasus IIIs and performance tests at Felixstowe during 1935 gave exceptionally fine

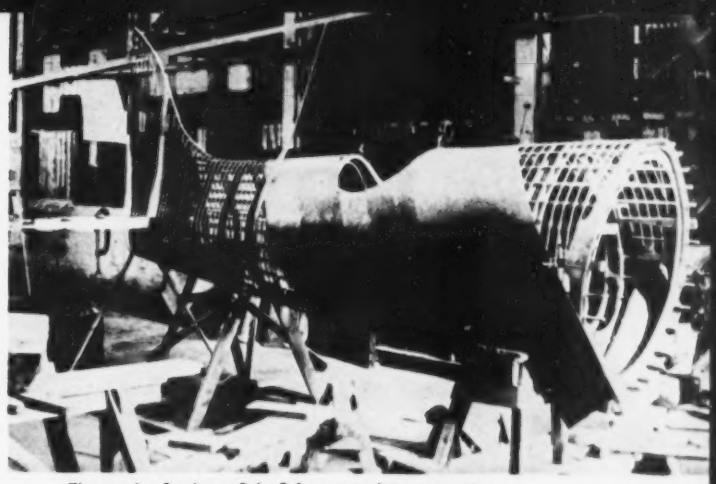
results, the maximum speed being 153 m.p.h. Pegasus Xs, later installed in the production version, named Stranraer, added 12 m.p.h. Stranraers were also built by Vickers in Canada, and as late as 1951 examples were still operating on the Canadian Lakes.

Mitchell's progressive cleaning up of his flying boats was a natural process and owed little to the Schneider seaplanes; but in the design of a new landplane fighter a degree of Schneider influence was discernible. This new four-gun fighter appeared in 1934; it was known by its specification number F.7/30, and unofficially as the Spitfire. To be truthful, the name was hardly merited, for the machine was a somewhat clumsy-looking cranked-wing cantilever monoplane of no less than 46ft span and having a fixed, "trousered," undercarriage. Even a neatly installed Rolls-Royce Goshawk of 600 h.p. failed to propel it at more than 230 m.p.h.

The F.7/30 having come to nought, Mitchell next envisaged a much smaller and neater machine with a retractable undercarriage and an enclosed cockpit, but retaining the Goshawk engine. While this was still on the drawing-board the Air Ministry specification F.5/34, calling for eight wing-mounted Browning 0.303in guns, was put out, and at about the same time Rolls-Royce came forward with their P.V.12 engine (later to be known as the Merlin) of about 1,000 h.p. Now, at last, Mitchell brought all his Schneider experience into play, and round a new private-venture design of his the historic F.37/34 specification was virtually written. The prototype machine bore the Service number K5054 and was certainly the prettiest military aircraft of that—or perhaps of any other—period. It was finished in pale blue and was characterized by a thin wing, of elliptical plan form, into which the very clean single-strut units of the undercarriage retracted laterally. The radiator for the Merlin C engine was placed under the starboard wing and the airscrew was a fixed-pitch, wooden two-blader of impressive dimensions.

The Spitfire I, as the new type was officially named, was first flown on March 5th, 1936, by J. ("Mutt") Summers, chief test pilot of the Vickers group. In June—by which time the Spitfire had proved itself the fastest fighter in the world, with a speed of 349.5 m.p.h.—the Air Ministry placed an order for 450; but before the first Spitfire Is could enter service R. J. Mitchell, who had been seriously ill for many months, died. It was written of him in *Flight:* "It was perhaps the ability of 'R.J.' to weigh the pros and cons quickly and to arrive at a decision which made him the great designer he undoubtedly was. His versatility will be appreciated when it is pointed out that his productions ranged from heavy long-range flying boats to tiny single-seater landplane fighters, and on more than one occasion he had two or three very different types of aircraft passing through the design stage at the same time, so that he frequently had to switch his mind from one problem to another of a totally different character. The success of Supermarine aircraft is proof that he was able to do this without losing that perfect judgment which is the essential of good compromise."

It was evident that the Spitfire was capable of being developed further (though at the time the great number of successive variants which eventually materialized were certainly not envisaged), and the great responsibility for modification and redesign then passed to the hands of Mr. J. Smith, who continues today as Supermarine's chief designer.



The wooden fuselage of the S.4 racer under construction.

The production form of the Spitfire I was a trifle less easy on the eye than the prototype, though its speed had risen to 362 m.p.h. The first R.A.F. squadron to be re-equipped was No. 19 and in the same year—1938—Supermarine Aviation Works (Vickers), Ltd., as the company was then known, together with their parent company, Vickers (Aviation), Ltd., were taken over by Vickers-Armstrongs, Ltd.

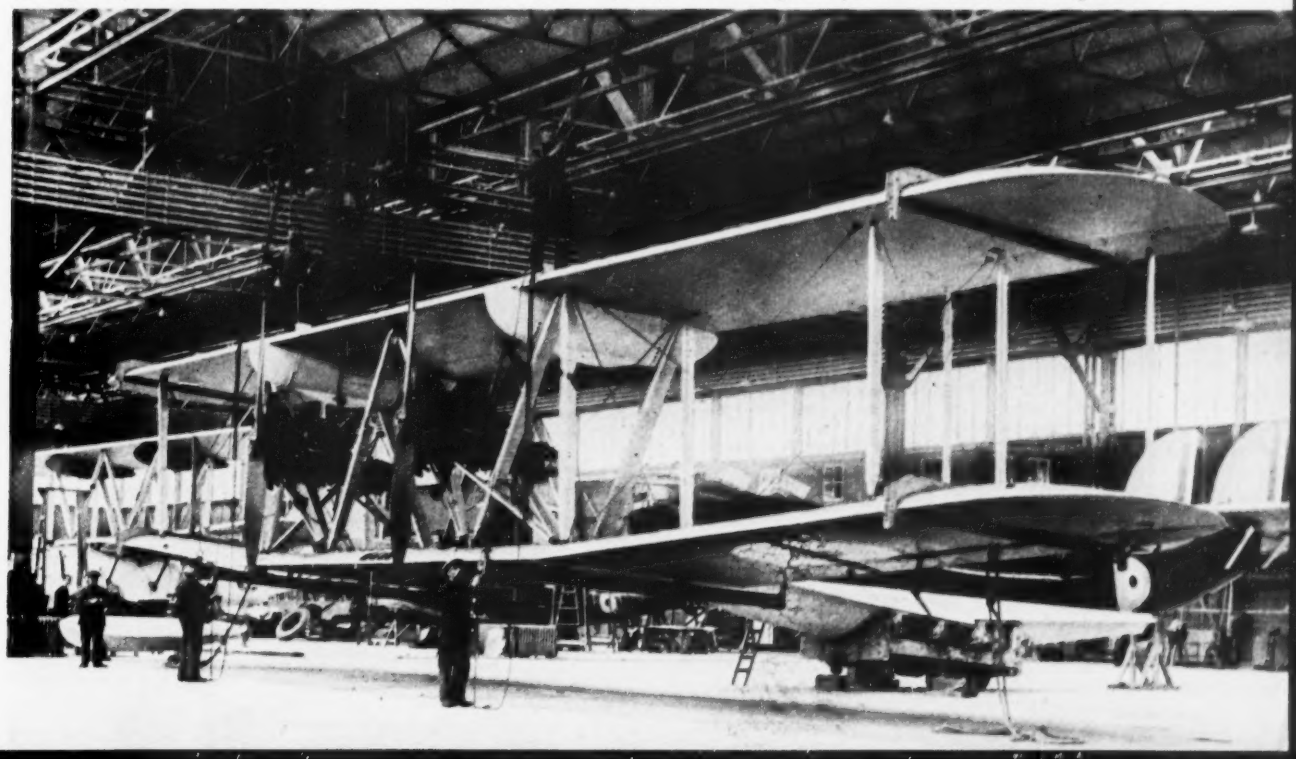
It was in 1938, too, that the "Speed Spitfire" made its unpublicized appearance. This had a special Merlin of 2,150 h.p. and was capable of well over 400 m.p.h. Eventually it was modified for an attempt on the world's speed record, but development work had not been completed when war broke out, whereupon a standard Merlin was installed and the machine was used for P.R. development work.

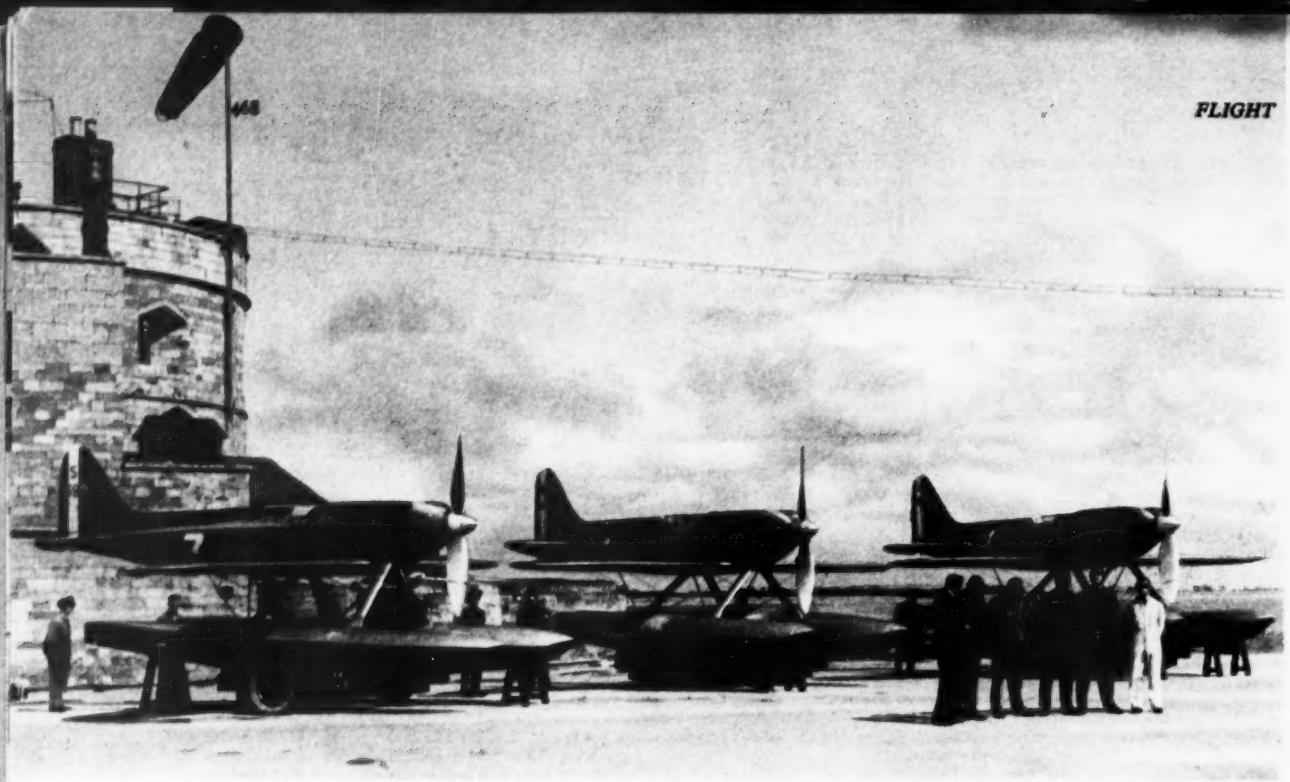
Throughout the year 1939 Supermarine's own production of their splendid new fighter was mounting, and a great shadow factory was being erected at Castle Bromwich for the Nuffield organization. Still, the marine aircraft side was far from being neglected, and it was during 1939 that the Sea Otter amphibian, with Bristol Mercury engine driving a tractor airscrew, was tried out as a successor to the Walrus. Spitfire production commitments were such, however, that Sea Otters for the Fleet Air Arm had to be sub-contracted to Saunders-Roe.

It is little known even today that on the outbreak of war there was under construction at Woolston a four-engined Supermarine bomber, to Specification B.12/36. Work was well advanced when the factory was severely bombed in 1940 and further work on the prototype was called off.

Henceforward our story is largely that of the Spitfire—that epitome of stubborn defiance and technical resourcefulness. Its deeds, and those of its companion-in-arms the Hawker Hurricane,

Hoisting the superstructure of a wooden Southampton, complete with twin Lion engines, prior to lowering it bodily on to the hull, seen in the background.





The British Schneider Cup team at Calshot in 1931, with the two Supermarine S.6Bs (right and left) and an S.6A, developed from the 1929 S.6.

SIRES OF THE SWIFT . . .

form one of the most glorious chapters of the history of the air war. They remain—and will continue to do so for many a year—fresh in our memories, so that we may concern ourselves here with technical characteristics, rather than combat achievements. We merely remark in passing that the Spitfire saw action in Great Britain, Europe, the Middle East and the Far East; that it was flown—and loved—not only by pilots of the R.A.F. and Commonwealth Air Forces, but by those of America, Poland, Czechoslovakia, Free France, Holland, Belgium, Norway and Yugoslavia; and that over 22,000, in thirty-three main variants (including Seafires), were built.

These we review in some detail later; but our present theme of Supermarine development demands a résumé of evolution and of conditioning factors.

The first enemy aircraft to fall to the guns of Spitfires were among those which sporadically raided our shores in the "phoney" war; but the supreme trial and proving of the "Spit" came in the Battle of Britain. Then it was that, alongside the Hurricanes, the Spitfire Is and IIs (the second mark had a Merlin XII engine in place of the Merlin III) tore the great, contrailing, formations of Heinkels, Dorniers and Junkers apart and lashed their escorting Messerschmitts till the onslaught faltered and ceased. Then the Spitfire achieved as great a measure of immortality as an aircraft ever could.

The earliest Spitfires had been fitted with fixed-pitch, two-blade, wooden airscrews, and later with two-pitch, three-blade de Havillands; but these did not allow development of full performance and, while the Battle of Britain was being fought, D.H. or Rotol constant-speed airscrews were being fitted. Many of these were field-modifications of earlier types. Latterly, on a number of machines, the eight machine-guns were replaced by a pair of 20-mm Hispano cannon in order to penetrate the German armour plate.

As was to be expected, the Woolston factory came under heavy attack and the fine buildings which had grown round the site of P.B.'s sheds suffered grave damage. But loss of life was relatively small, and most of the Spitfire production line survived or was salvaged, together with the vital machine tools. After a visit by Lord Beaverbrook, the resolute Minister of Aircraft Production, came the order to disperse; whereupon the headquarters of the company, together with the design staff, were transferred to a stately country house at Hursley Park, near Winchester. Workshops were set up in various southern towns, and by 1944 Supermarines were established in 61 dispersals.

All the time modifications and innovations were being introduced to meet specific requirements; thus, when the Woolston works were bombed, a Spitfire I was being mounted on Blackburn Roc floats with a view to its employment in the Norwegian campaign, though the collapse caused the scheme to be shelved. The Spitfire floatplane was, however, revived in 1942, and three Mk Vs (this time with specially designed floats) were formed into a section and operated in the Mediterranean. A Mk III Spitfire was built, as a private venture, with a two-stage Merlin 20 and cropped wing-tips, and two Mk Is were modified at Farnborough for high-altitude photo reconnaissance.

One of the most famous variants of all was the Mk V—first-string of Fighter Command in 1941 and 1942. Tropicalized versions of the V served extensively abroad and it was a Mk V which was first adapted to take a Rolls-Royce Griffon in 1941. This was originally called Spitfire IV, though the mark number was later changed to XX to avoid confusion with the P.R.IV. The Mk VI was a long-span high-altitude version of the Mk V, hastily improvised to tackle Ju 86P nuisance raiders, and it was, incidentally, the first British fighter to have a pressurized cockpit. An even higher-flyer was the Mk VII, with Merlin 61. The Mk VIII was virtually an unpressurized version of the VII and it appeared after, perhaps, the most successful Spitfire of all—the Mk IX. This was Britain's considered reply to the Fw 190 and 5,609 examples were built. The pressurized Mk X was a P.R. development of 1944—far less common, this, than the Mk XI.

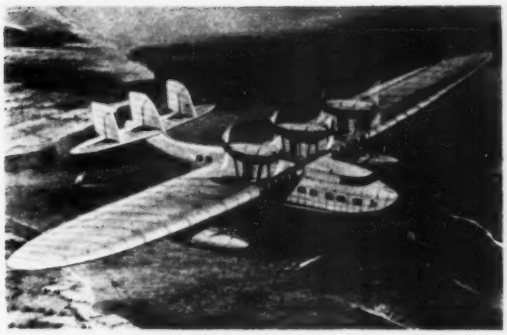
As in the frozen heights so at "deck-level" did the "Spit" achieve supremacy. Thus, to counter low-flying tip-and-run fighter/bombers a hundred strengthened Mk V airframes were fitted with Griffon III low-altitude engines, the resulting machines being designated Spitfire XII. For low-level photographic reconnaissance there was the Mk XIII.

When the Griffon became available in quantity the Spitfire XVIII was designed for that magnificent engine; so urgent was the need for such a fighter, however, that an interim type, the Mk XIV, was evolved. Mks XV and XVII did not materialize.

The Mk XVI was a version of the IX with the American Packard-built Merlin. Over 1,000 were built at Castle Bromwich. The Mk XVIII resembled the XIV, but had strengthened wings and increased tankage, and the P.R.XIX had "Bowser" wings and a Universal camera installation. Last of the great line of wartime Spitfires were the 21 and 22. They were distinguished by a wing of completely new design and of greater strength and area, and some examples had six-blade Rotol counter-rotating airscrews. There was no Spitfire 23 and the 24 was a strengthened 22.

Should the more studious reader seek first-hand enlightenment regarding this evolutionary complex, he is commended to a paper delivered by Mr. J. Smith before the Royal Aeronautical Society on December 19th, 1946, and paraphrased in *Flight* a week later. Therein, too, he may trace the lineage of the Seafire, which was to the Fleet Air Arm what the Spitfire was to the R.A.F. Briefly, this was the way of its development:

The prototype Seafire was really a "hooked" Spitfire, but the production Mk I had catapult spools in addition. The Mk II was similar, though with two 20-mm guns and four .303in guns instead of the 8 × .303 armament; and the Mk III had folding



Impression of the six-engined flying-boat project of 1930.

Seafires and a Sea Otter aboard H.M.S. "Vengeance."

wings. Next came the Mk XV, with Griffon engine; then the Mk XVII, with rear-view canopy and sting-type arrester hook. The Mk XVIII had an engine change and the Mk 45 was really a Naval version of the Spitfire 21. A rear-view hood characterized the Mk 46, and the 47 (which, like some 46s, used contra-rotating airscrews) had folding wings and other improvements.

The main volume of Spitfire and Seafire experimental flying was the responsibility of Supermarine's Experimental Flight Test Department at Worthy Down, and later at High Post. Here as many as 30 aircraft, engaged on various forms of experimental flight-test work, were sometimes to be seen together.

Space does not allow a detailed citation of the war record of the Sea Otter and Walrus, though this was a fine one, as many a ditched crew-man will bear enthusiastic testimony. It would, of course, be an overstatement to assert that the Sea Otter was a lineal descendant of Pemberton Billing's P.B.1; but it is certainly true to say that this machine (and, for that matter, the later Seagull monoplane also) can trace its ancestry directly back to the old A.D. boat and biplane Seagull.

Affectionately known to all at Supermarines as "Dumbo," and built to Air Ministry Specification S.24/37, a torpedo/bomber/reconnaissance machine was tested during 1943, completion of the two prototypes having been delayed by Spitfire and Seafire development and production. The most remarkable feature of this wooden monoplane was a variable-incidence wing, from which a wealth of flight data—invaluable in the development of the Seagull monoplane—was forthcoming.

Though diving tests had shown that the Spitfire possessed remarkably good Mach number characteristics, it was considered that a new wing would be advantageous. Thus the Spiteful was created—a strikingly handsome machine, though lacking some of the Spitfire's daintiness. It used a deeper, stiffer fuselage, conferring improved pilot-vision and—of greater importance—incorporated a tapered, laminar-flow wing.

Production of the Spiteful was in hand when the war ended, but the type never saw active service, nor indeed was it ever issued to a squadron. It made its mark, however, in 1947, by achieving 494 m.p.h. on the level—the highest speed recorded under such circumstances by a piston-engined machine in this country, or possibly in the world. The Seafang was the Naval version, almost identical in appearance.

So promising were the high-speed qualities of the Spiteful that Specification E.10/44 was issued for a Nene-turbojet fighter to use a similar wing. The first flight of this projectile-like machine was made by Jeffrey Quill in July, 1946. Two further examples were built to Specification E.1/45 and flown in 1947, and, after searching trials with these, the Attacker (as the new type was eventually named) was ordered for service with the Royal Navy. Equipment of the first squadron began in August, 1951—some 3¼ years after M. J. Lithgow (who was appointed chief test pilot during 1948) had taken the first prototype round a 100-km closed-circuit at the record speed of 564.881 m.p.h.

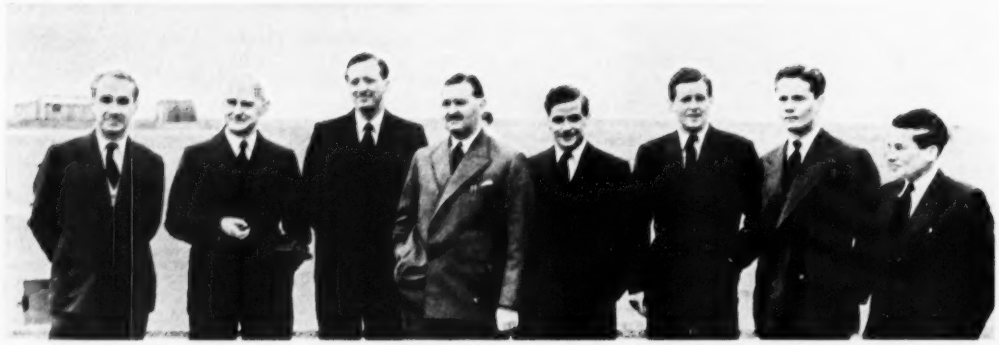
Post-war development was not concerned with jet fighters alone; an appealing two-seater trainer variant of the Spitfire was developed, and the Sea Otter was converted for civil use. Both types were exported. Intended to succeed the "Otter" in the Naval air/sea rescue rôle (though helicopters eventually took over the commitment), the Seagull monoplane amphibian was test-flown in 1948. Griffon-powered, it embodied a variable-incidence wing and demonstrated the remarkable speed range of 54-260 m.p.h.

In 1950, L. R. Colquhoun, flying a Seagull, set up a 100-km closed-circuit record for amphibians at 241.9 m.p.h. This record still stands.

Not unnaturally, having regard to past achievements, jet fighters became the company's main line of business. It soon became clear that, efficient as was the Spiteful/Attacker wing, further increases in speed must be sought with the aid of sweepback, so new designs were put in hand and in December, 1948, a "swept Attacker," bearing Supermarine Type Number 510, took the air. In "navalized" form this was to become the first swept-wing fighter to land aboard an aircraft carrier. The date was November 8th, 1950, and the ship H.M.S. *Illustrious*. With an afterburner the 510 became the 528, and with a nosewheel undercarriage (in which form it appeared at the S.B.A.C. Display of 1950) the 535.

In the 535 is seen the last link in the chain before the 541, or Swift, the maiden flight of which took place on August 1st, 1951. Differing from its forerunner in having a Rolls-Royce Avon axial-flow unit in place of the centrifugal Nene, the first Swift was prevented by bad luck and a belly-landing (made by test pilot "Dave" Morgan, under the most creditable circumstances) from appearing in the S.B.A.C. Display of 1951; thus, it could not be compared with its rival, the Hawker P.1067—now famous as the

Spitfire IXs operating from a newly occupied airfield in the Naples area.



Seen on the occasion of the visit of His Royal Highness the Duke of Edinburgh to the Supermarine airfield at Chilbolton earlier this year are, left to right: Jeffrey Quill, O.B.E., A.F.C. (chief liaison officer); J. Smith, C.B.E., F.R.Ae.S., A.M.I.Mech.E. (chief designer); M. J. Lithgow (chief test pilot); S. P. Woodley, M.B.E. (superintendent, Supermarine Works); and test pilots L. R. Colquhoun, G.M., D.F.C., D.F.M., D. W. Morgan, G. J. Horne and J. W. C. Judge.

SIRES OF THE SWIFT . . .

Hunter. Some months earlier, however, an order was placed "off the board," and so it is that the first production Swifts are now about to enter service with the R.A.F.

With its supersonic capabilities, an armament of four 30-mm cannon and obviously large fuel stowage, the Swift is the sort of machine that pilots of Fighter Command have pined for too long. The signs are that it will prove itself a second Spitfire—and could anything augur better for the Command and for Supermarine?

Born in salty air, Supermarines are staunch supporters of the Royal Navy, and development on behalf of that Service has not ceased with the Attacker, for this April brought news of a substantial order for carrier-based fighters "developed from the Type 508." The first 508—a straight-wing single-seater with two Avons—appeared at the S.B.A.C. Display of 1951, and, restricted in speed though it then was, it showed phenomenal climbing powers. The second example—Type 529—has since been flown, but appears to differ little from the first. Production versions will have swept surfaces, and from this advantage, in concert with two high-thrust Avons, another great Supermarine fighter must surely result.

Our last word, for the present, is for the Swift F.4, positioned as we write in North Africa for an assault on the 727-m.p.h. record of its formidable rival, the Hunter. Whatever the outcome of this sporting venture, "Joe" Smith can be sure of one thing: that his old chief, R. J. Mitchell, would have been well pleased. The Swift is his sort of aeroplane.

Swift F.4, holder of the London-Paris record—212.5 miles in 19 min 5.6 sec (669.3 m.p.h.).

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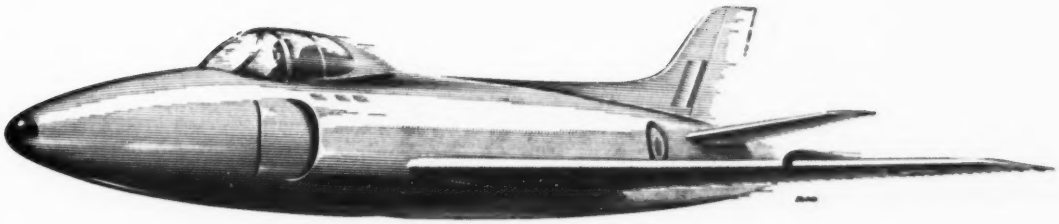

VICKERS SUPERMARINE

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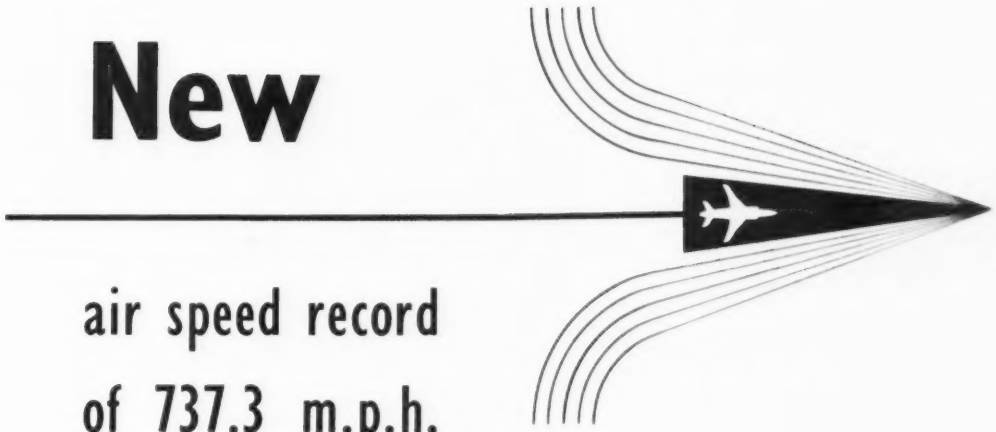

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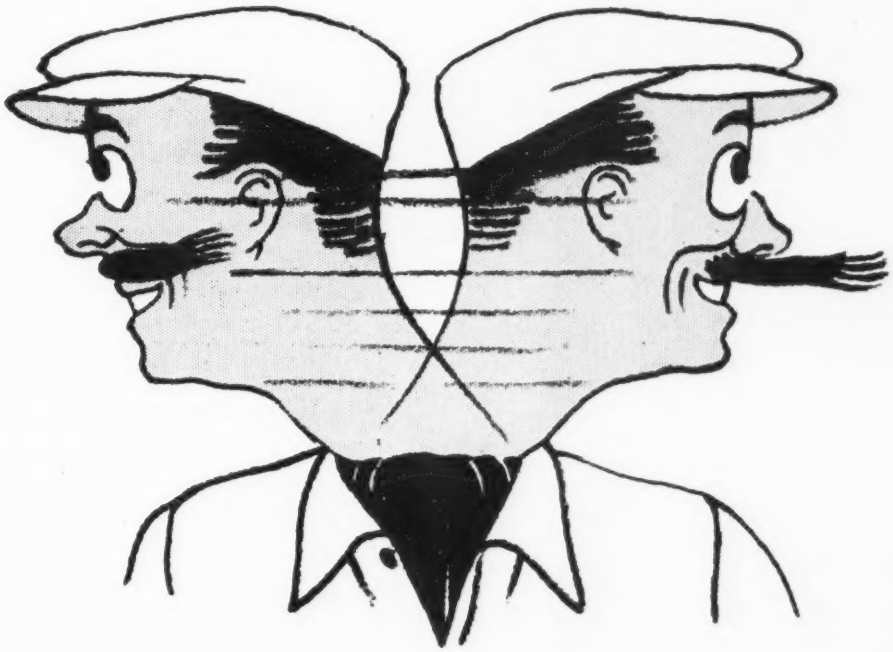

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Mike Lithgow in his Supermarine Swift F.4 aircraft,
powered by Rolls-Royce Avon engine
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SIRES OF THE SWIFT

PART II: THE FAMILY ALBUM

HAVING traced the growth of Supermarine, and placed the company's products and achievements in chronological order insofar as this has proved practicable, it remains to give some more detailed description of the aircraft types and certain of their variants. (It must be recognized, of course, that variations on the Spitfire theme alone could easily fill the entire space at our disposal.)

As we have seen, a number of designs underwent a lengthy period of development, and sub-types of these appeared at long or short intervals over many years—often interspersed with totally new machines. To enable the development of a particular design to be more readily followed, therefore, it seems convenient to group the various types according to period or class. The fact that the Navyplane, Sparrow and Dumbo do not fall into any of the six main categories is further indication of Supermarine versatility.

P.B.9.

The P.B. Days

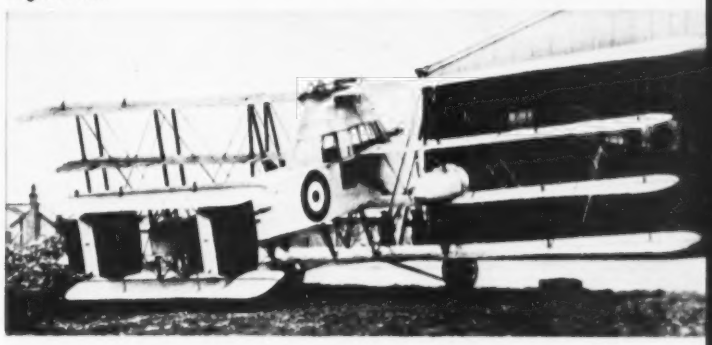
P.B.I.—When this little tractor flying-boat was shown at Olympia in 1914 *Flight* remarked that it differed radically from any machine of the type hitherto turned out in this or any other country. A cleanly installed 50 h.p. Gnome drove a three-blade tractor airscrew, and the outboard stabilizing floats were sprung to adapt themselves to undulations of the water. The pilot's seat, behind the wings, was quickly detachable so that in case of accident the pilot could throw it overboard. We read that "as it possesses sufficient buoyancy to keep a man afloat, it serves the purpose of the lifebelt frequently worn by pilots of waterplanes." Construction of the cigar-shaped hull was ingenious: the upper part consisted of two layers of spruce and the thickness of the lower portion was carefully proportioned according to the loads imposed upon it. The step formed a separate structure, riveted to the main hull. The P.B.1 was never flown.

P.B.9.—The only engine available when this tiny biplane scout (the "Seven-Day Bus") was built soon after the outbreak of war in 1914 was an old 50 h.p. Gnome, which is said to have developed no more than 18 h.p. on the bench. Yet the machine attained 78 m.p.h. and climbed at over 500ft/min. Until the time that the R.N.A.S. became part of the R.A.F. it was serving as a trainer at Hendon.

Push Proj.

Push Proj.—Originally built with straight wings, this little pusher scout later had sweepback. The engine was a 100 h.p. Monosoupape, the armament a Lewis gun, and the speed 98 m.p.h.

Night Hawk.



Night Hawk.—Best described as a "patrol fighter", the Night Hawk was a massive quadruplane, built for the R.N.A.S. and powered with two 90 h.p. Austro-Daimler engines fitted with silencers. A Davis recoilless gun firing a 1 lb shell was fitted in the uppermost position, and four machine guns were disposed round the fuselage. Equipment included a searchlight and incendiary flares, carried in a revolving chamber, which enabled them to be dropped in a stick across a Zeppelin. Two Night Hawks were built—the first in seven weeks from commencement of design.

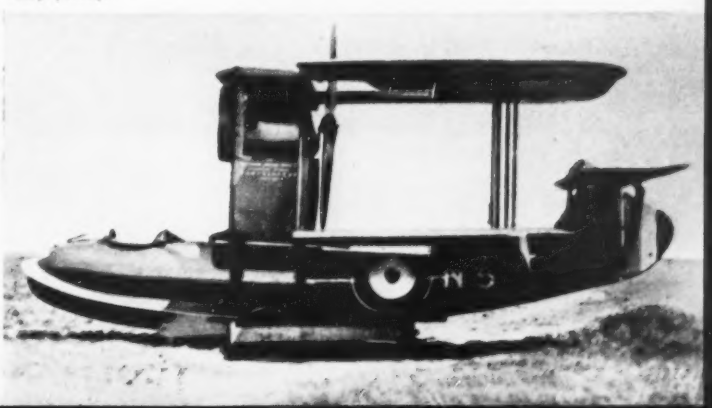
Amphibians and Little Boats

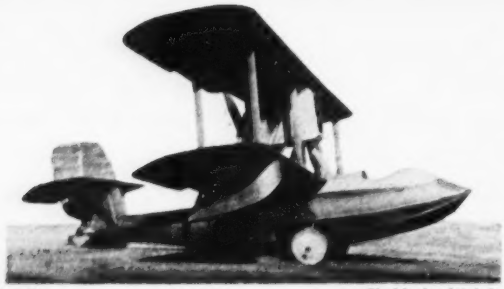
A.D. Boat.—This pusher flying-boat was sponsored by the Admiralty and, though the letters A.D. are said to connote "Admiralty design," the whole machine, with the exception of the hull, was redesigned by Supermarine. Built on the Linton Hope "flexible" system of construction, the hull accommodated a crew of two, one of whom had a Lewis gun. The 200 h.p. Suiza engine had fuel for 4½ hr and the service load included wireless. Jettisonable wheels were fitted for taking off from land or ship launching-platforms, and a curious feature was the biplane tail, with reverse camber on the upper plane. The lower mainplane was watertight, as it was largely submerged when taxying. Span was 50ft 4in and length 30ft.

Baby (N.1B).—The Baby was Supermarine's first single-seat fighter flying-boat and it was built to Admiralty requirements. The wings, of 30ft 6in span, were arranged to fold for shipboard stowage, and the engine was a Hispano-Suiza of 150 or 200 h.p. With the former a top speed of 117 m.p.h. was attainable. Flying at its gross weight of 2,326 lb the Baby was highly manoeuvrable, and there is a record of it having been looped twice during February, 1918. The pilot had an excellent fighting view and was armed with a single Lewis gun.

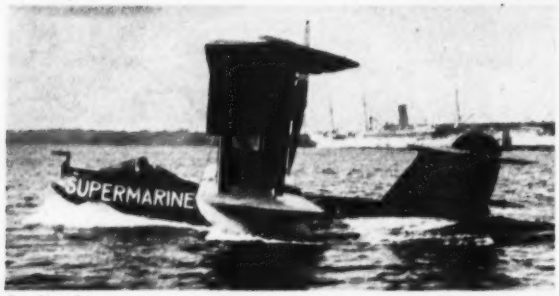
Sea King.—Slightly larger than the Baby, this amphibian was built in two forms—the Sea King I, having a 160 h.p. Beardmore engine, and the Mk II with a 300 h.p. Hispano Suiza. The first was shown at Olympia in 1920 and on that occasion a speed range of 59 to 110 m.p.h. was claimed. *Flight* described the Mk II in detail during April, 1922. It was remarked that the machine should have a performance equal, or nearly so, to that of a land machine of the same power; thus the Sea King may be considered as the S.R./A.1 of its day. It could be looped, rolled and

Baby (N.1B).

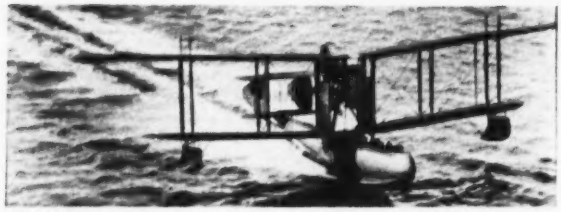




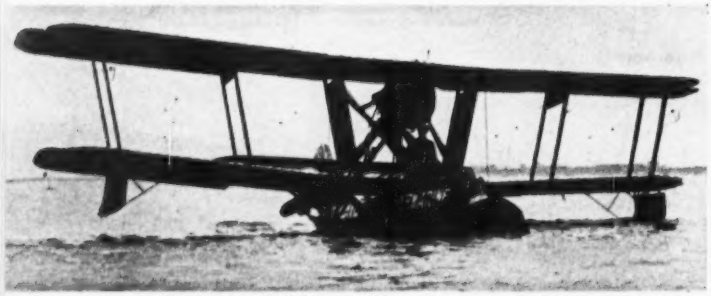
Sea King II. Sheldrake (right).



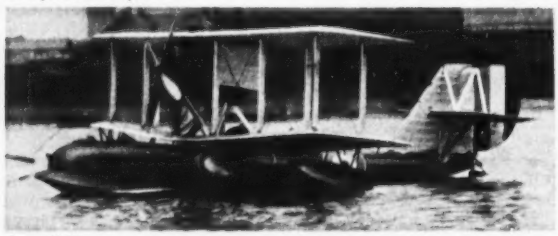
Sea Lion I.



Channel.



Competition amphibian.



Seagull III.

Above, Sea Eagle. Below, Scarab.

SIRES OF THE SWIFT . . .

spun with impunity, and was armed with a Lewis gun. The span was 32ft and the gross weight 2,850 lb.

Channel.—A post-war development of the A.D. boat, the Channel was laid out for commercial operation, carrying a pilot and three passengers. The engine of the Mk I machine was a 160 h.p. Beardmore, but the Channel II had a 240 h.p. Siddeley Puma and a redesigned step for cleaner running. Span and length were 50ft 4in and 30ft respectively, and the wings were arranged to fold forwards. Military versions were developed for various foreign governments. That supplied to Chile was, according to a contemporary account, "fitted with dual controls, the latest and most up-to-date wireless telegraphy and telephony sets, bomb-dropping gear for practice with dummy bombs, and a machine gun mounted in the nose."

Seal and Seagull Biplanes.—These were not distinct types, but versions of the same airframe. The characteristic Supermarine circular-section hull was retained but the Napier Lion engine drove a tractor, instead of a pusher, airscrew. There were two marks of Seal and four of the Seagull (not including the Seagull V, which eventually became the Walrus). The Seagull II differed from the Mk I in tankage arrangements and other details, and the Seagull III, which was produced in quantity for the R.A.F. and the R.A.A.F., carried all its fuel beneath the top centre-section. The Mk IV was an experimental machine fitted with Handley Page slots and flaps and twin rudders.

Sea Lion.—There were three marks of the Sea Lion, the first of which was a cleaned-up Sea King with a Lion engine and with the undercarriage removed. The Mk II—a development for the 1922 Schneider Race, in which it was victorious—differed in having a redesigned bow, fin and rudder, and the Mk III, which, in racing trim, achieved a maximum speed of 175 m.p.h., was distinguished by clipped wings, revised engine cowling and modified hull. A feature of the Sea Lion design (and, for that matter, of the Sea King also) was the ease of engine maintenance; the wing and engine mounting could be removed from the hull by releasing eight bolts.

Competition Amphibian.—For the Air Ministry's competition for commercial amphibians held during September, 1920, Supermarine entered a biplane powered with a 360 h.p. Rolls-Royce Eagle VIII, which drove a pusher propeller. The planing surfaces were larger than those of the Channel and the bows of the hull more pointed, resembling those of the Sea King. The wings did not fold. Two passengers were seated forward of the pilot, under a hinged "conservatory" roof. The pilot had a short tiller, by means of which he could steer the craft while standing up in the cockpit.

Sea Eagle.—This was another commercial amphibian, with a Rolls-Royce Eagle IX driving a pusher propeller. It was, however,

Walrus.

Seamew.

Sea Otter.

more commodious than the Competition amphibian, having seats for a pilot and six passengers. With that load fuel for 230 miles was normally carried, though the range could be extended by reducing the number of passengers. The maximum speed was 93 m.p.h., cruising speed 84 m.p.h. and landing speed 50 m.p.h.

Scarab.—A military development of the Sea Eagle, the Scarab was an amphibian bomber/reconnaissance type built for the Spanish Government. It was claimed for this craft, and for the Sea Eagle, that it was practically impossible to ship water over the cockpits. A water rudder allowed the machine to be turned on a radius of one span. There were carriers beneath the wings for a bomb load of up to 1,000 lb.

Sheldrake.—This was a little-known Supermarine type of 1927 (indeed, it seems already to have been forgotten by the makers themselves), and, as the *Flight* photographs suggests, was an experimental development of the Seagull, with revised hull lines. The engine was a Lion V.

Seamew.—Resembling a "baby Southampton", this amphibian was powered with two Armstrong Siddeley Lynx geared engines and was intended for reconnaissance. It carried a crew of three and had Scarff mountings for two Lewis guns. The hull was of wood and the span the same as that of the Walrus, i.e., 46ft.

Walrus.—Originally known as the Seagull V, this very famous pusher amphibian was powered with a Bristol Pegasus engine. A private venture, it was designed for use on capital ships and was accordingly fitted with catapult gear. In Australian service the name Seagull V was retained and, though Walrus was the official R.A.F. name, "Shagbat" was an equally common appellation. The wings of the Mk I were of composite construction, with metal spars, wooden ribs and fabric covering, and the hull was of metal. The Mk II, built by Saunders-Roe, had a wooden hull.

Sea Otter.—Designed as a successor to the Walrus, the Sea Otter was powered with a Bristol Mercury 30 engine, driving a tractor airscrew. Construction was mixed, the hull being of metal and the fabric-covered wings having metal spars and wooden ribs; the tailplane was plywood-covered. The two main fuel tanks were in the inboard sections of the upper wings, and additional fuel could be carried in the hull. The crew numbered three or four, and the armament was three Vickers "K" guns.

Seagull S.14/44.—The Seagull monoplane of 1948 was vastly different from the original craft of that name. Intended as a replacement for the Walrus and Sea Otter, it was a parasol monoplane with high-lift, variable-incidence wing, developed from that of the S.24/37 Dumbo torpedo/bomber. The speed range of 4.81 : 1 was achieved with the aid of electrically operated leading-edge slats and slotted trailing-edge flaps, the outer portions of which were double-slotted. Although the Seagull weighed 200 lb more than the Southampton, it measured only 50ft 6in in span, whereas the "Soton" spanned 75ft and was, into the bargain, a biplane.

Seagull (S.14/44).

Big Boats

Swan.—The Swan was the first twin-engined flying-boat built by Supermarines, a previous project for a small three-seater twin around 1919 having been shelved. It had high, flared bows, as had the Sea Eagle, and the pilot sat in a raised "deckhouse" above the lower centre-section. Both Rolls-Royce Eagle and Napier Lion engines were fitted. The civil version carried ten passengers, with baggage, for 300 miles. It weighed 13,700 lb and had a cruising speed of 92 m.p.h.

Southampton I, II and III. — The first three marks of Southampton may be defined as: I, wooden hull, Lion engines; II, metal hull, Lion engines; III, metal hull, geared Jupiter engines. The crew numbered five—two pilots, a navigator/bomb-aimer and two gunners. The duralumin hull of the Mark II was anodically treated against corrosion and the basic structure was 540 lb lighter than that of the Mk I. Elimination of water seepage permitted a further 400 lb of fuel to be carried and increased the range from 680 miles to nearly 900 miles. During 1932 two Southampton airframes were converted to take steam-cooled Rolls-Royce Kestrels; these were not, however, known as Mk IVs, that designation being reserved for the redesigned machine later known as the Scapa.

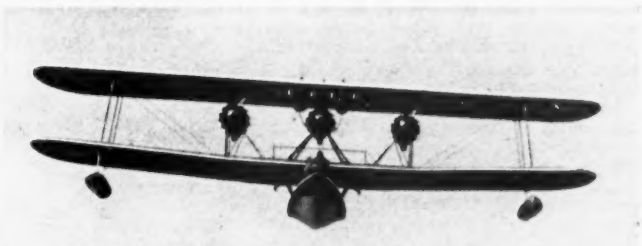
Nanok (Solent).—The hull and tail of this machine were similar to those of the Southampton, but the wing cellule was considerably different and carried three Armstrong Siddeley Jaguars mid-way between the wings. Built as a torpedo carrier for the Danish Navy, it was not taken up by that Service when it was realized that, having regard to the size of the aircraft, manœuvrability was insufficient for such a hazardous role. The Nanok was accordingly converted for service as a private air yacht and renamed the Solent.

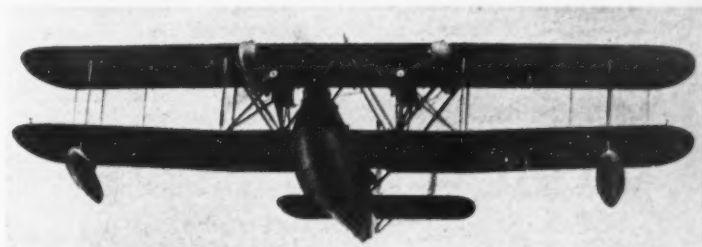
Air Yacht.—The Solent rendered such satisfactory service when used as an air yacht by the Hon. A. E. Guinness that the same gentleman ordered this special monoplane boat, again with three Jaguar engines. Apart from the monoplane wing the most striking feature of the machine was the use of sponsons instead of lateral stabilizing floats. The Air Yacht was metal-constructed and had fabric-covered wings. For various reasons the machine was overweight and it was finally sold to a new owner and sent to the south of France, where it was wrecked in a storm.

Scapa.—Originally designed Southampton IV, the Scapa had two Rolls-Royce Kestrel medium-supercharged engines mounted snug beneath the upper mainplanes. Compared with the hull of the Southampton, that of the Scapa was relatively straight-sided and of considerably greater capacity. The cockpit was enclosed (one Southampton II had been experimentally fitted with an enclosure) and there were three gun positions. The loaded weight was 16,050 lb and the maximum speed 142 m.p.h.

Southampton X.—Originally powered with three Panthers, this type subsequently had three Jupiters. It bore little or no resemblance to any preceding Southampton, being in the first place a sesquiplane, and having a flat-sided hull with stainless steel plating below the waterline. This was another of the Supermarine boats which proved somewhat heavy and the Southampton X never saw service.

Stranraer.—This was the last of the large Supermarine biplane

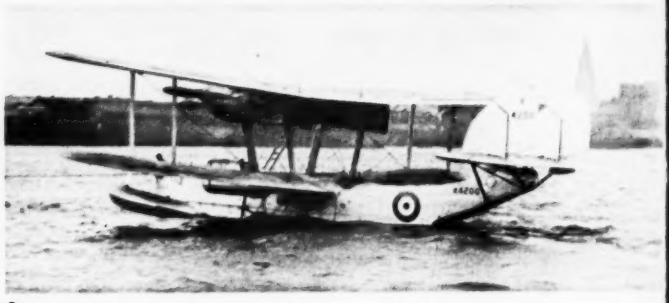




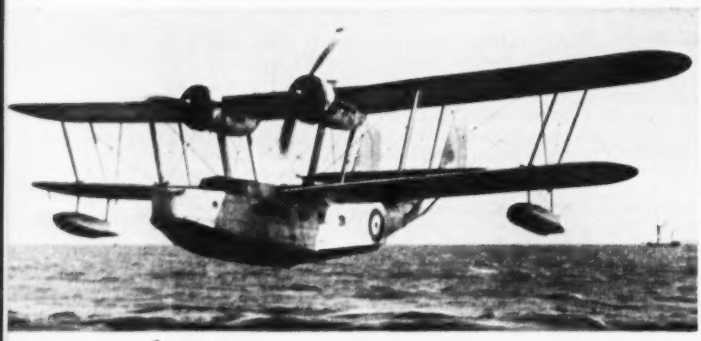
Above, Nanok (Solent). Below, Southampton Mk X.

Above, Southampton II. Below, Air Yacht.

Southampton (Kestrels).



Scapa.

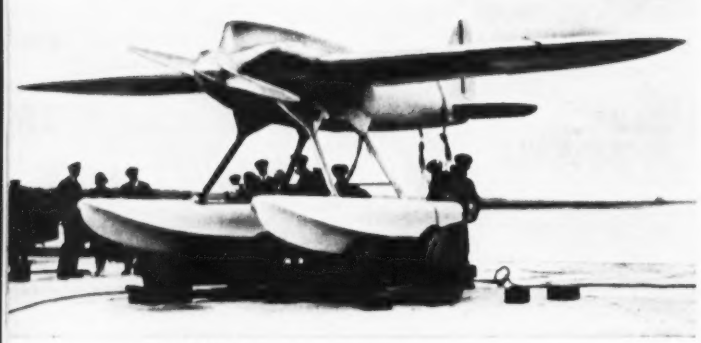


Stranraer.

SIRES OF THE SWIFT . . .

flying-boats and was originally called Southampton Mk V. The hull was similar in design to that of the Scapa but larger, and had an additional gun position in the extreme stern. The wing structure had an extra bay. A feature was a self-contained slinging gear for engine changing, and provision was made for carrying a spare engine or torpedo on the lower centre-section. The span was 85ft, length 55ft, and gross weight 19,000 lb.

Supermarine's contemporary brochure avers: "The outstanding feature of this flying-boat is that the performance obtained during a series of extended service trials, whether in respect of speed, climb, ceiling or take-off, is unequalled by any other British flying-boat. All the specification requirements were exceeded by large margins. The severe test of flying with one engine stopped was easily accomplished."



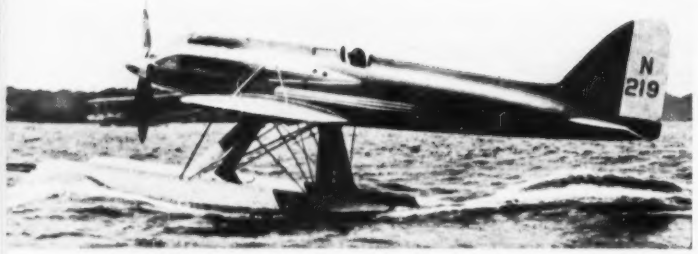
S.4 of 1925.

Schneider Seaplanes

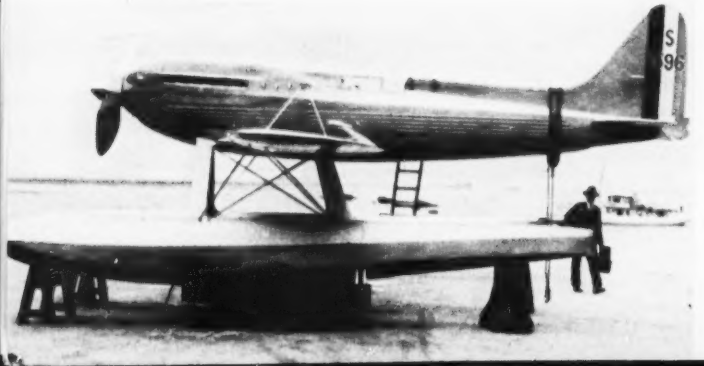
S.4.—This cantilever mid-wing monoplane racer was principally of wooden construction with three-ply covering taking a share of the stresses. Inboard of the ailerons were trailing-edge flaps which reduced the landing speed to about 90 m.p.h. (still decidedly "hot" for the period). The wooden floats were attached to the fuselage by four high-tensile tubes in streamline fairings and the direct-drive Napier Lion was cooled by two Lamblin radiators under the wing. A duralumin airscrew was fitted.

S.5.—Essential differences between the S.5 and the S.4 were that the S.5 had a low-set wire-braced wing, the fuselage and floats were of duralumin construction, and the cockpit was placed further forward. The special Lion engine gave a higher speed, 283.66 m.p.h. having been clocked over 100 km. Three examples of this extremely pretty little racer were built.

S.6.—Somewhat resembling the S.5, the S.6 was larger and heavier, having been built to take the Rolls-Royce R-Type engine, specially developed for racing; thus, the cowling lines were very different from those of the S.5. The radiators, as on the S.5, formed the wing covering and added no drag. Construction was all metal. Whereas the S.5 had a cantilever engine mounting, on the S.6 the front float struts were moved forward to provide a support. The oil tank was in the fin.



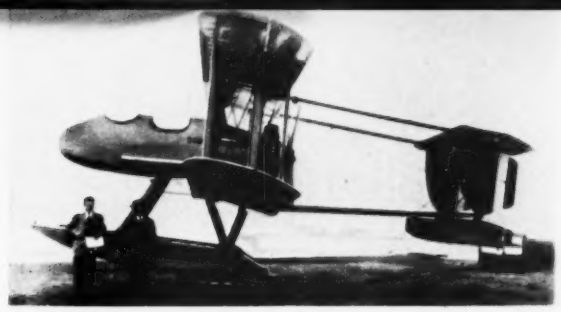
Above, S.5.
Below, S.6B.



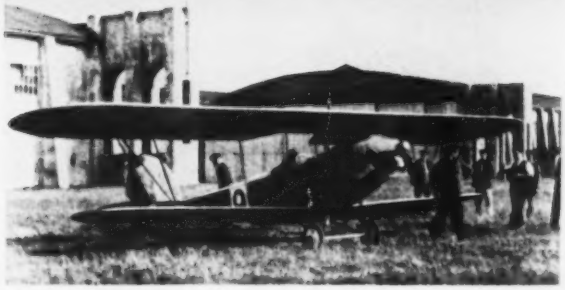
S.6A.—Two S.6s were modified to S.6As for the 1931 Schneider contest. They had new floats, giving improved water handling characteristics and carrying an increased fuel load. More cooling surface was added by utilizing the tops of the floats, and the control surfaces were mass-balanced. The gross weight was 5,250 lb and the wing loading 36.2 lb/sq ft.

S.6B.—The two 1931 Schneider Trophy S.6Bs had, like the S.6As, new and larger floats, wherein the fuel was redistributed to balance the torque of the more powerful Rolls-Royce R engine, especially at take-off. The entire upper and lower surfaces of the wings and the upper surfaces of the floats were used as water radiators, and the oil coolers down the sides of the fuselage were of improved type. Various components were strengthened.

Indicative of the problems attending the development of these historic racers is the curious point which arose in connection with the airscrews in 1931. The new screws produced by Faireys were of 8ft 6in diameter, as compared with 9ft 6in for the 1929 S.6. With these it proved impossible to take off, owing to the fact that at an early stage the machine swung violently to port, even with full starboard rudder. With the old 9ft 6in airscrews, however, take-off was easy—in fact, a great improvement owing to revised float design. Eventually 9ft 1½in airscrews were found to give satisfactory take-off, while with an 8ft 10in screw it was only just possible to get off under very favourable conditions.



Navyplane.



Sparrow sesquiplane.

Odd Three Out

Navyplane.—This twin-float pusher seaplane was sponsored by the Admiralty and was designed to take the Smith radial engine, which was not a success. A Bentley A.R.1 rotary was substituted for trials, conducted by Lt.-Cdr. John Seddon. The nose incorporated a glass screen to afford the best possible field of view for reconnaissance, and the observer was provided with wireless. The gun mounting was of the pivoted traversing type.

Sparrow.—The Sparrow lightplane, of 1924, was the first land machine to be built by Supermarines since the Pemberton Billing days. For the 1924 Lympne Competition it was arranged as a sesquiplane, the two wings being of different sections. The engine was the tiny Blackburne three-cylinder radial and the gross weight was under 900 lb. A speed range of 27-72 m.p.h. was claimed and the ceiling was 11,000ft. The 1926 version, seen on the right, was a parasol monoplane, fitted with a Bristol Cherub flat twin.

S.24/37 ("Dumbo").—This experimental deck-landing torpedo/bomber/reconnaissance aircraft bore the Supermarine Type Number 322. Two prototypes were built, the first with a Merlin 30 and the second with a Merlin 32. The most striking feature was the variable-incidence wing, pivoted on the main spar and electrically actuated. Additionally, there were Handley Page leading-edge slots, and the entire trailing edge was hinged. The fuselage was of wooden construction and a great deal of wood was also used in the wings. The gross weight was about 12,000 lb and the top speed nearly 280 m.p.h.

Sparrow monoplane.

S.24/37 ("Dumbo").

F.7/30 (Spitfire).

Spitfire I prototype.

Speed Spitfire.

Spitfire II.

Spitfire and Seafire

Spitfire I.—Production-type Mark Is differed from the original version of the prototype in having ejector exhausts, a tailwheel in place of the skid and numerous other small modifications. The Mk IA had eight 0.303in guns and the IB two 20 mm guns and four 0.303in guns. The original fixed-pitch wooden airscrew was replaced by a D.H. v.p. or c.p. three-blader.

Speed Spitfire.—This special machine was built in 1938 and had an experimental boosted Merlin. At one stage the massive underwing radiator was completely removed and the coolant was allowed to boil away. The tail skid was retained and the windscreen specially faired. When war came a standard Merlin was fitted.

Spitfire III.—In this experimental mark a Merlin XX engine drove a three-blade Rotol airscrew. The wing spar and undercarriage were strengthened and a larger radiator was necessary.

Spitfire IV (later Spitfire XX).—This was another experimental development, with a Griffon IIB engine, which flew during 1941. One version had provision for six 20 mm guns. To avoid confusion with the P.R.IV the designation was later changed to Spitfire XX.

Spitfire P.R. IV.—A Merlin 45, large leading-edge tanks and a wing oil tank distinguished this unarmed photographic-reconnaissance version.

Spitfire V.—The engine of the Mk V was a Merlin 45, 46, 50, 50A, 55 or 56. The VA and VB corresponded in armament to the IA and IB, and the VC had universal-armament wings, later with provision for carrying two 250 lb bombs. Low-altitude versions had special Merlins and clipped wing-tips.

Spitfire VI.—The first British fighter with a pressure cabin, this machine had a wing span of 40ft 2in (the standard span was 36ft 10in) and a Rotol four-blade, constant-speed airscrew.

Spitfire VII.—A redesign of the Spitfire to take the Merlin 61 series engine, with two-stage supercharger. The wing-tips were extended to take full advantage of the power at altitude, and the tailwheel was retractable. Some Mk VIIs had deep-chord

Spitfire III.

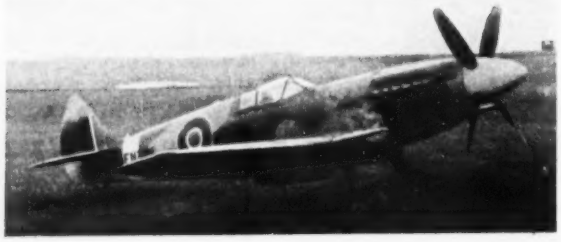
Spitfire IV.

Spitfire VC.

Spitfire VI.

Spitfire VII.

Spitfire IX floatplane.



Spitfire XII.

Spitfire XIV.

Spitfire XIX.

SIRES OF THE SWIFT . . .

pointed rudders. Armament: 2 x 20 mm plus 4 x 0.303in guns. A number of Mk VIIs were equipped for P.R. work.

Spitfire VIII.—The Mk VIII was essentially an unpressurized Mk VII. Variants were the F.VIII, with Merlin 61, 63 or 63A, and standard wings; the low-altitude fighter, L.F.VIII, with Merlin 66 engine and standard wings; and the high-altitude H.F.VIII, with Merlin 70 and long-span wings.

Spitfire IX.—Merlins of the 61, 62, 66 and 70 series were installed in this mark, which was essentially similar to the VC but with the engine and twin-radiator installation introduced on the Mk VII. "F," "L.F." and "H.F." variants were put into service, and certain Mk IXs had "E"-type wings, with two 20 mm and two 0.5in guns.

Spitfire P.R.X.—An unarmed reconnaissance machine with Merlin 64 or 71, the fuselage and engine installation of the Mk VII, and Mk VC wings, adapted to house additional tanks.

Spitfire P.R.XI.—A cleaned-up reconnaissance variant with Merlin 61, 63 and 70 engine, and with a large drop tank, having a range of about 2,000 miles. A recognition feature was the bulging of the under-cowling to house an extra oil tank.

Spitfire XII.—This special low-altitude fighter was the first production-type Spitfire to have the Griffon engine (Mk III or IV). The airframe was essentially that of the Mk VC but was specially strengthened. The wings had "clipped" tips and the armament was 2 x 20 mm plus 4 x 0.303in guns. Two squadrons of Spitfire XIIs were operational.

Spitfire XIII.—The airframe of this mark was essentially that of the VB but it was adapted for low-level photographic reconnaissance. The four machine guns were retained.

Spitfire XIV.—A high-altitude fighter with Griffon 65 two-stage, two-speed engine, extra-careful finish, and redesigned tail. The F.XIVE had two 20 mm + 2 x 0.5in guns and (on later aircraft) a rear-view hood; the F.R.XIVE had provision for an oblique camera and carried additional fuel. The top speed of this mark was 442 m.p.h.

Spitfire XVI.—Essentially a clipped-wing Mk IX, this version had the Packard-built Merlin 66. Later versions had a rear-view hood and additional fuel.

Spitfire XVIII.—Basically a Mk XIV, with strengthened wings and increased tankage.

Spitfire P.R.XIX.—The Griffon 65 or 66 engine of this fast, high-flying reconnaissance machine drove a five-blade Rotol airscrew. The wings were similar to those of the Mk XIV but carried additional fuel. Most XIXs had pressurized cockpits. This was the fastest operational mark of Spitfire, with a speed of 446 m.p.h.

Spitfire 21.—The wings of the Mk 21 were completely redesigned and of slightly increased area. The tail was also modified, and the undercarriage strengthened. Armament was four 20 mm guns.

Spitfire 22.—This was similar to the 21 but had a rear-view hood and a 24-volt, instead of a 12-volt, electrical system.

Spitfire 24.—The final production version of the Spitfire—almost identical with the Spitfire 22 but with a strengthened undercarriage and additional fuselage tanks.

Spitfire Floatplanes.—The first Spitfire floatplane had Blackburn Roc floats but was abandoned at the termination of the Norwegian campaign, for which it was being built. Later three Spitfire Vs were converted and used operationally in the Mediterranean. A Mk IX on floats is illustrated.

Spitfire Trainer.—A post-war tandem-seat, dual-control development familiar at air races in Great Britain and exported in small quantities. The prototype was a converted Spitfire VIII.

Seafire I.—This first Naval development of the Spitfire had the Merlin 32, 45 or 46 engine, an arrester hook and catapult spools. Armament was eight 0.303in guns.

Seafire II.—A development with alternative armament provisions. A number of Mk IIs were eventually fitted for reconnaissance.

Seafire XV.—Resembling the Spitfire XIV, this important Seafire development had the Griffon VI engine and strengthened,

Spitfire 21.

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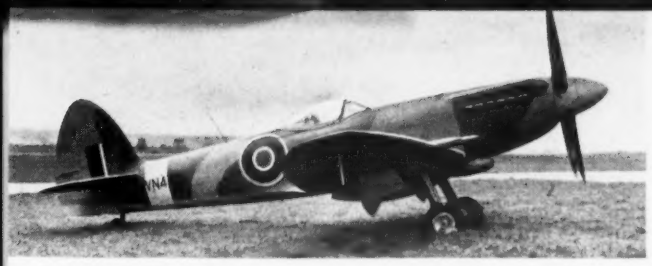


Spitfire 24.

Seafire I.

SIRES OF THE SWIFT . . .

folding wings. Later models had a sting-type hook.

Seafire XVII.—An improved Seafire XV with strengthened undercarriage, rear-view hood and sting-type arrester hook.

Seafire XVIII.—Work on the prototype of this mark, which was to have the Griffon 36 engine, was stopped before completion.

Seafire 45.—A Naval counterpart of the Spitfire 21, with sting-type hook and Griffon 61 engine.

Seafire 46.—Similar to the 45, but with the Spitfire 22-type rear fuselage and canopy. Some machines had Rotol contra-rotating airscrews.

Seafire 47.—Fitted as standard with contra-rotating airscrews for its Griffon 85, the Seafire 47 had folding wings, revised flaps and increased tankage. The F.R.47 had two cameras.

Spiteful to Swift

Spiteful XIV.—The Spiteful was designed to Specification F.1/43 and, though bearing a family resemblance to the later Spitfires, was a completely new aircraft. The most notable advance was the adoption of tapered wings with squared tips. Deeper and more streamlined, the fuselage carried a larger tail-plane and a new fin and rudder assembly, also used on the ultimate types of Spitfire and Seafire. The narrow-track under-carriage of the earlier Supermarine fighters having been open to some criticism, the adoption of an inward-retracting, wide-track gear was of considerable significance. A Griffon 69 engine was fitted.

Spiteful XV.—Contra-rotating Rotol airscrews were fitted to the Griffon 89 or 90 engine of this development.

Spiteful XVI.—With a Griffon 101 three-speed-blower engine, this development of the Spiteful XIV achieved a speed of 494 m.p.h. at 28,500ft during official tests at Boscombe Down. The sea level speed was 408 m.p.h. and the maximum rate of climb 4,750ft/min.

Seafang 31.—Built to Specification N.5/45, this was virtually a "hooked" Spiteful. The engine was a Griffon 69 and the wings did not fold.

Seafang 32.—A production version of the Mk 31, with increased tankage, folding wings and Griffon 89 engine driving a Rotol contra-rotating airscrew.

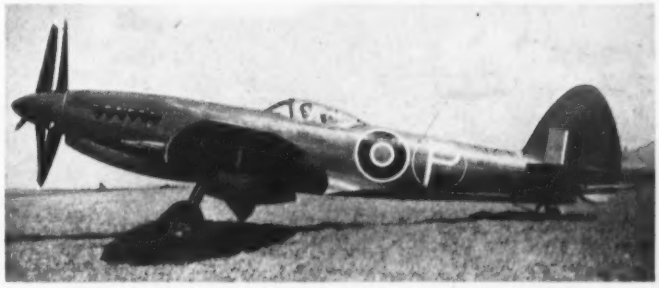
Attacker F.1.—The basic Attacker design stems from Specification. E.10/44, issued before the end of the war for an aircraft to utilize the Rolls-Royce Nene turbojet. Incorporating the wings and undercarriage of the Spiteful, the prototype was a land-based machine, but the second and third examples, to Specification E.1/45, were adapted to meet Naval requirements and had the long-stroke, pre-retracting undercarriage, as originally designed for the Seafang. Carrier trials took place during October, 1947. After a number of Attacker F.1s had been delivered to the Royal Navy, a quantity of similar aircraft, without Naval fittings, went to the Royal Pakistan Air Force. The F.1 is armed with four 20 mm wing-mounted guns, has a span of 36ft 11in, weighs 11,500 lb, and has a maximum speed of about 590 m.p.h.

Attacker F.B.1 and F.B.2.—These are fighter/bomber developments for the Royal Navy carrying, in addition to full ammunition for the four 20 mm guns and 250-gal drop tank, two 1,000 lb bombs or eight rocket projectiles under the wings.

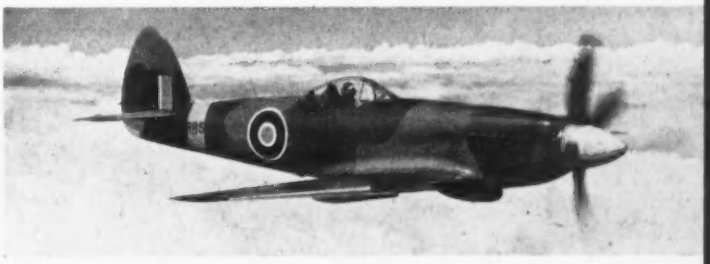
Type 510.—The excellent design of the Attacker fuselage and power plant installation was a convenient foundation upon which to base full-scale experimentation with swept wings and tail surfaces, and design work to this end was begun in 1945. The outcome was the Type 510 research aircraft, two examples of which were built. The first machine flew one year and nine months after the placing of the development contract. The wings were of Supermarine laminar-flow section and had a single main spar, auxiliary rear spar, and plate ribs. Slotted ailerons, split trailing-edge flaps and dive-recovery flaps were fitted. Originally designed with an Attacker-type nose, the 510 also appeared with a pointed nose. During November, 1950, the second of the two prototypes completed deck-landing trials aboard H.M.S. *Illustrious*. For this purpose it was fitted with an arrester hook and rocket-assisted take-off gear.

Type 535.—A progressive development of the 510, with redesigned wing, nosewheel undercarriage, lengthened nose,

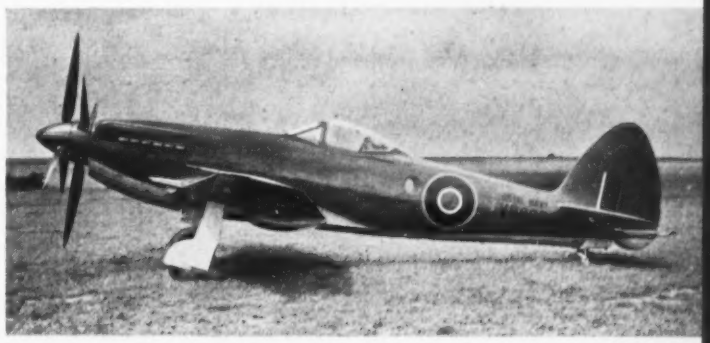
Seafire III.



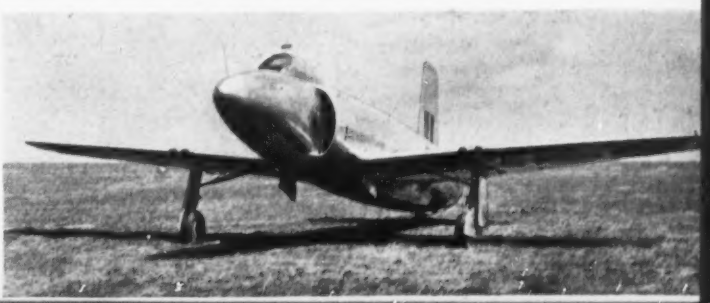
Seafire 47.

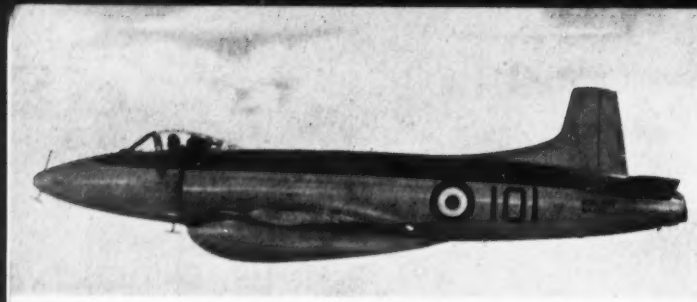


Spiteful.

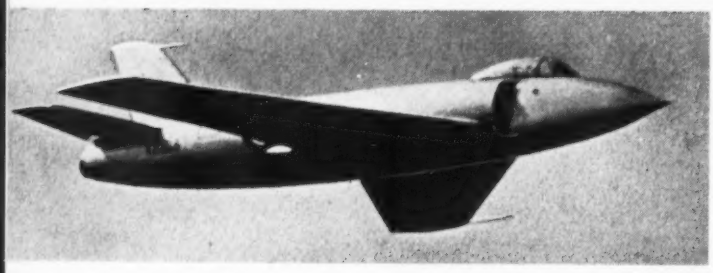


(Above) Seafang. (Below) Attacker prototype (E.10/44).



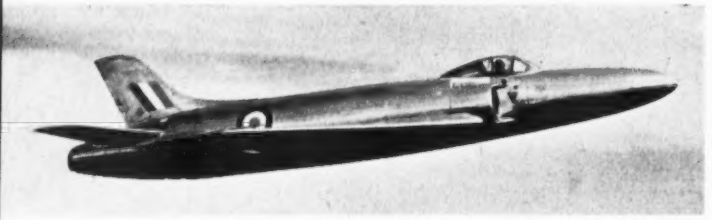


Attacker (production type).



Type 510.

Above, "Navalized" Type 510. Below, Type 535



SIRES OF THE SWIFT . . .

revised tail, and having an Attacker-type twin-tailwheel unit in addition to the nosewheel, the 535 first flew during August, 1950. Use of the tailwheels made possible a conventional tail-down landing with corresponding braking effect, due to the high angle of attack of wings: The Nene turbojet was retained.

Type 541 Swift.—This was the prototype of the Swift, and differed from the Type 535 in having enlarged intakes for the axial Avon turbojet. The tailwheel installation was deleted.

Swift F.1.—Developed as a day intercepter fighter from the Type 535, the Swift F.1 was fitted with Service equipment and guns (2 x 30 mm) and put into limited production for the R.A.F. The "four-point" undercarriage (or more strictly "five-point," the tail-wheel being double) and long nose of the 535 were discarded in favour of a normal tricycle gear and short nose; the engine intakes were carried forward to the level of the cockpit windscreen, and the guns were mounted in the lower fuselage beneath the pilot. A number of F.1s were completed and delivered to the R.A.F. for evaluation. As work progressed, development was continuing and several important modifications were introduced to increase performance and firepower. These resulted in the F.4 which is the version eventually to go into large-scale service.

Swift F.2.—This interim mark of Swift retains the original Avon, without reheat, but features two additional 30 mm guns. These are mounted beneath the fuselage, between the guns mounted under the intake ducts.

Swift F.3.—First demonstrated at the recent S.B.A.C. Flying Display, the Swift Mk 3 is virtually a reheat Mk 1. There are a number of other detail alterations, but the increased power is the main change, the big afterburner and tail-pipe necessitating a number of cooling-air intakes above the fuselage. Like the Swift F.2, this mark retains the cranked wing leading-edge.

Swift F.4.—The basic external differences between the F.1 and F.4 are in the tailpipe, tailplane, wing plan, armament and gunsight. The Avon engine has reheat; the tailpipe is consequently longer and has a nozzle area which can be varied by the use of "eyelids." The tailplane is of "all-flying" type, in which the control column moves the tailplane directly, the elevators playing a purely secondary role; the wing plan has also been modified by sweeping the inboard section of the leading edge forward, as in the Mks 2 and 3. Armament of the F.4 corresponds to the new British fighter standard of four 30 mm cannon, for which space has been found in the under-fuselage. F.4s seen recently are also fitted with the radar gunsight, nose-mounted gun camera and a buried aerial along the leading edge of each wing, close to the fuselage. Various arrangements of wing fences have been observed on the Swift 4, but the latest arrangement consists of one long, fairly deep fence from the leading edge to a point just forward and outboard of the inner edge of the ailerons. A number of intakes on the top of the fuselage over the engine bay have recently been fitted; these are of the flush type, developed by the N.A.C.A. in America.

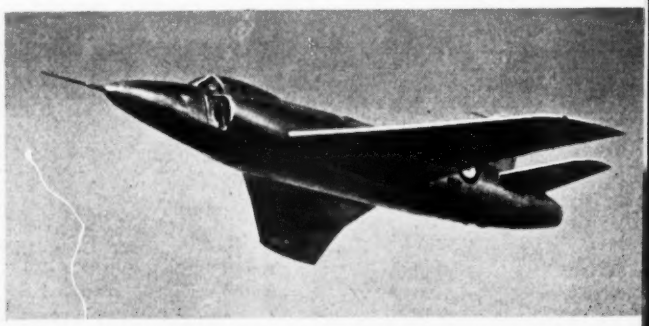
An interesting feature of all Swifts is the combined speed-brake and flap. The flaps themselves are of very large area and, because of their deep chord, the hinge line is some distance forward of the wing trailing edge. Trim change on extension at high speeds should therefore be comparatively small. It is thought that the dive-brake control operates the first flap position and that a second lever controls the full range of movement.

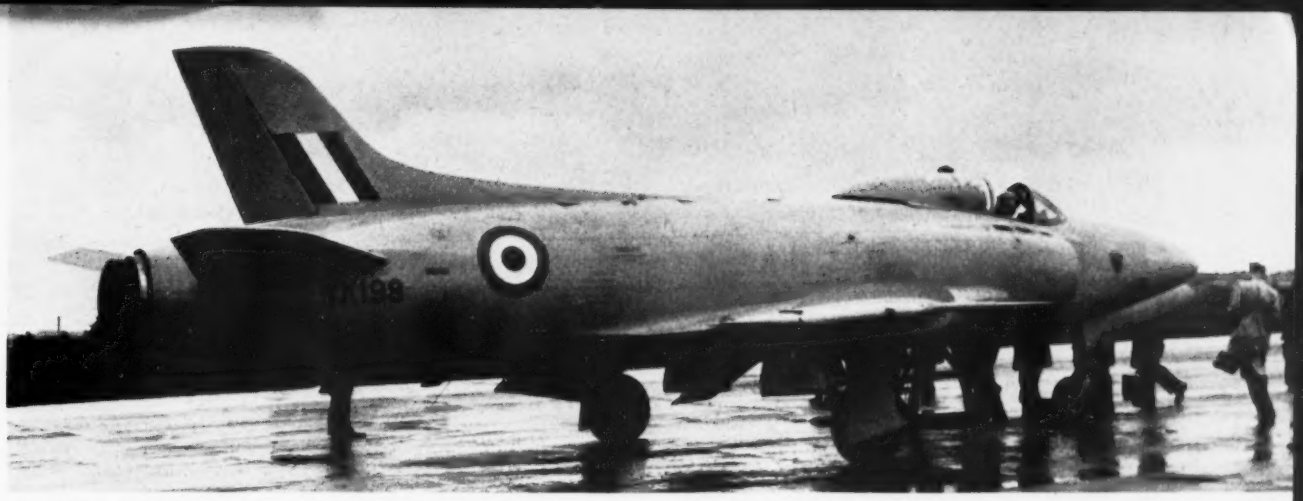
Types 508 and 529.—The few weeks preceding the S.B.A.C. Display of 1951 were significant ones for Supermarines. The Type 541 Swift had flown on August 1st, and on September 5th came an announcement of the maiden flight that day of a new Naval twin-jet fighter designated Type 508. It was a machine of singular appearance, having an extremely thin straight wing, two Rolls-Royce Avon turbojets housed in the fuselage sides, and a "butterfly" tail unit, in which the hinged trailing portions worked as elevators (operated together) and as rudders (operated differentially). When it appeared at Farnborough more novel features were observed, including "droop-snoot" leading edges, which, in conjunction with the large flaps, conferred a moderate landing speed. Four large gun ports (presumably for 30 mm weapons) were visible beneath the air intakes. The first deck-landing trials, aboard H.M.S. *Eagle*, were undertaken by M. J. Lithgow early in 1952. The Type 529 differs only in minor respects from the 508.

Type 508 Development.—In April this year it was announced that an order had been placed for a substantial quantity of "twin-jet fighters developed from the Supermarine 508." The aircraft concerned is reported to be designated Type 525 and has swept-back wings and a conventional tail.

Type 529. (Type 508 is similar).

Swift F.1.





The Swift F.4 at Supermarine's Chilbolton airfield, in Hampshire, prior to its departure for Libya on September 22nd to attack the world's speed record.

SIRES OF THE SWIFT

PART III. MACHINES AND MEN

By Jeffrey Quill, O.B.E., A.F.C.

IT was suggested that I should write something about some of the more interesting aeroplanes with which I was concerned during the eleven-odd years that I flew for Supermarines. I find this difficult because, ever since I learnt to fly twenty-two years ago, I have found nearly every aeroplane of absorbing interest.

However, it is clear that I must start with the prototype Spitfire, K.5054. I first flew this machine on March 26th, 1936, quite soon after its first flight which had been made by J. Summers. It is entered in my log simply as "Supermarine Fighter K.5054." I was 24 years old and had done about 1,300 hours flying; and from that day onwards I, with my friend the late George Pickering, did the bulk of the development testing on this machine, apart from what was done at Martlesham. In those days Bulldogs were still in service in the R.A.F., the Gauntlet was their newest fighter; the Gladiator was perhaps just about to go into service and there were still Virginias flying about. The prototype Hurricane had been flying at Brooklands since the previous November.

A monoplane fighter was something of a novelty anyway, but a fighter with the performance of K.5054 was a good deal more than that in those days. The Hurricane was the only aeroplane in the world which approached anywhere near it, for the Americans didn't seem to take fighter development very seriously and the German Me 109 was powered with an engine of, speaking from memory, only about 600 b.h.p. as against the 1,100 b.h.p. of the Merlin III.

Apart from anything else, therefore, flying the Spitfire was the greatest possible fun and I have seldom enjoyed anything so much as the two years during which we flew K.5054 whilst awaiting the emergence of the first production machine in May, 1938.

The impression has once or twice been given that the Spitfire was "right, from the word go." This is not strictly correct. We had our full share of troubles, headaches and frights during that period and it was all full of interest. I personally was keenly aware of the privilege of working for R. J. Mitchell. But it would need a book to record all this. One point of interest is that K.5054 was, I think, one of the first aeroplanes to be fitted with an anti-spin parachute. It had shown up badly in the spinning calculations at R.A.E. and there was thus a certain amount of gloom about the prospects for the actual spinning tests. The cable of the anti-spin parachute was attached to the fuselage just forward of the fin; it was then led along the outside of the fuselage, secured by sticky tape, and the parachute itself stowed in the cockpit.

The idea was that, if in trouble, one opened the canopy, seized a handful of parachute and flung it over the side—preferably the appropriate side. I well remember the first spin, entered at 20,000 feet from a strangely silent stall with the big two-bladed wooden airscrew ticking over very, very slowly. But eight years elapsed before I actually had to use an anti-spin parachute (in a Seafire with an experimental rudder), and it broke my leg—but that is another story. The only difficulty we had with the prototype was persuading the R.A.E. that the spin recovery characteristics were, in fact, perfect. It seemed they had no business to be, but they were.

In 1936 Supermarine was still primarily a flying-boat firm. George Pickering was the flying-boat pilot and one of the very best. I had practically never seen a flying-boat and I was lucky to have him to teach me to fly them. Like the true expert that he was he made no mystery about it, and very soon I was happily splashing about in Walruses, Stranraers and an occasional Scapa.

The Walrus was one of the most remarkable aeroplanes ever built. There are those who have flown them and those who have not, and it is idle for the former to try to explain matters to the latter. The Walrus did an incredible variety of jobs and could operate in very heavy seas.

In the air they clattered along in the course of their various duties, swinging gently from side to side with a pendulous motion and keeping up a steady directional oscillation. If the Walrus' flight characteristics were measured and recorded by modern methods the man who wrote AP.970 would probably have a heart attack. It was perhaps one of the best and most useful aeroplanes ever produced.

The main story of the development of the Spitfire during its eleven years of production life has been told elsewhere. From the flight development point of view the problem was primarily a race to maintain and improve the handling characteristics in the face of rapidly increasing speed, all-up weight, power, airscrew solidity and operating altitudes, not to mention diversity of operational roles and ever increasing quantities and sizes of "external stores." All modifications and alterations made in the interests of handling had to be such as could be developed quickly and incorporated in the production line without slowing the ever-increasing tempo of production.

More often than not the obvious aerodynamic answer had to be abandoned because it meant too radical a change to be practical from the production/time viewpoint, and some sort of aerodynamic "fiddle" adopted instead. On the whole, the inevitable conflict of interest between "design" and "production" was resolved by Supermarines as well and as successfully, I think, as was humanly possible. But it meant some give-and-take on all sides and some of the "give" inevitably had to be on the "handling" side.

It was none-the-less galling, on occasions, to encounter people whose sole pre-occupation in life was the study of flight characteristics and to be told something like "what you want to do with the Spitfire Mark so-and-so is to double the tailplane area."

As if we didn't know.

I always thought the best of the Spitfires for handling were the later Mark VIIIs with standard wing tips and Merlin 66 engine, and perhaps the worst was the Mark 21. However this latter machine had an outstanding performance as a combat aeroplane, having an unrivalled combination of speed, climb and turning circle. But by that stage of the war the emphasis was on air-to-ground fighter operations, and air-to-air combat performance, such as possessed by the Spitfire 21, had less significance then than it had in, say, 1940, '41 and '42. This, incidentally, is a point frequently overlooked. The basis of air superiority in any theatre in daylight is the possession of fighters which can outclimb, out-turn, outstrip and out-dive the fighters of the enemy, as well as their bombers. Only then (or in the case of the virtual collapse of enemy air opposition due to internal reasons) can a tactical air force operate with reasonable impunity against ground targets. At the beginning of any war such a collapse cannot be expected; therefore control of the air must be fought for in the air and fighters must possess real combat performance, at almost any cost.

However, there were only a comparatively few Mark 21's produced and the handling was put right on the Marks 22 and 24 with very little sacrifice of performance.

But to return to the original theme. The Spitfire floatplane

Lt.Cdr. M. J. Lithgow, Supermarine's chief test pilot, entering the Swift F.4 for his London—Paris record flight

SIRES OF THE SWIFT . . .

was, of course, a fascinating toy. Also of ever-present interest were the problems of trying to make the Spitfire into a suitable carrier-borne aircraft, i.e. Seafire, and at the same time keep its performance in line with current marks of Spitfire. Then the Spiteful gave us many problems and we did a lot of work in dives at (in those days) high Mach numbers. We also achieved with this aeroplane the remarkable speed in level flight of 494 m.p.h. "Dumbo," of the variable-incidence wing, was a most interesting experiment, and finally, in 1946, I flew our first jet, the Attacker TS.409.

Having written very briefly of some of the aeroplanes of Supermarine it would be appropriate to write of some of the pilots who flew them and did so much to help both the firm and me personally.

I have already mentioned George Pickering, who was quite fearless and full of energy. Desperately injured in a crash while testing a production Spitfire he had a long year of recovery and convalescence, only to be killed in a Bren-gun carrier the day after he was pronounced medically fit to fly again. There was Johnnie Wakefield, a great driver of racing cars before the war, who was killed in a collision while testing a PR. Mark IV. Then we had Don Robertson (now a stockbroker), who was an experienced pilot with a very highly developed critical faculty for all things mechanical, which he exercised with great tolerance and understanding. (There is incidentally, nothing worse than the intolerant or impatient test pilot who makes no effort to appreciate the problems and difficulties of designers and production engineers.) There was Alex Henshaw—a real master of aerobatics such as one only encounters rarely in the course of a flying life—with the responsibility for the testing of the vast production output of Castle Bromwich. The manner in which he coped with the winter weather conditions there, with no "aids," had to be seen to be believed. He was helped at Castle Bromwich by George Lowdell and George Snarey until the latter returned to the Supermarine end.

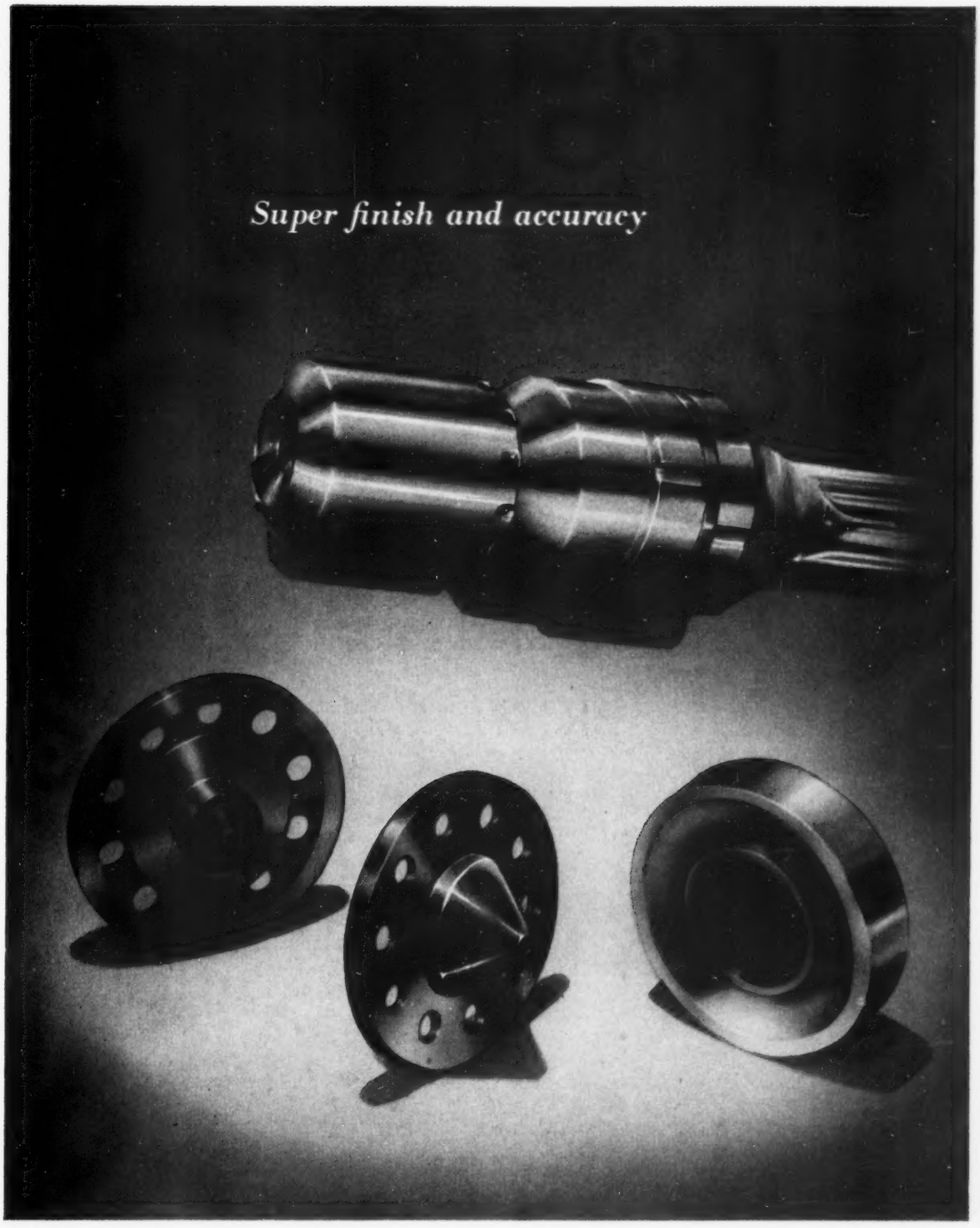
Then there was Frank Furlong, a man of unbounded exuberance and tremendous courage. He had no technical background—he was brought up with horses (he rode the winner of the Grand National in 1935); but he applied a deep-rooted intelligence and enthusiasm to test flying and in the hurly-burly of activity in our war-time experimental flight test department he was the ideal chap. He was killed in the prototype Spiteful in 1944.

And Guy Morgan, ex-P.R.U. pilot, now flying for Vickers Weybridge. He took charge of the testing of the whole of the production output of Supermarine, thus taking a great weight of worry and responsibility off my shoulders. For a time during the war George Errington came and flew for us; his experience and help, as well as his conversation, was highly stimulating. Then there was Pat Shea-Simmonds, our first E.T.P.S. graduate, who did much valuable work on Spitfires, Spitefuls and Seafangs before returning to his peace-time occupation after the war. John Derry came to us from C.F.E., on leaving the Service. I remember being greatly impressed with him when he walked into my office at High Post for his interview. Unfortunately circumstances were such that we could only offer him a temporary job; but the promise that he showed with us was amply borne out when he went to de Havillands a year later. Then there was Peter Robarts, who gave up much in order to continue with the flying which he loved. He died testing a production Attacker in 1950. In addition to these pilots who were part of the firm, we had many R.A.F. and Naval pilots attached to us. We could not possibly have coped with the enormous production output and experimental programmes without them. It is impossible to mention them all by name, but they mostly did a first-class job.

All the pilots who have flown for Supermarine, whether civilians or in the Service are inevitably part of the firm's history and have contributed something towards the firm's success, and some of them lost their lives in the process.

Our present team of test pilots is, I think, second to none. They all know their job thoroughly and get on with it quietly and effectively without fuss or notoriety. If there is one thing the writer can afford to be proud of it is that he was primarily responsible for choosing them. Working under Mike Lithgow their names, in case there may be anyone who doesn't know, are: L. R. Colquhoun, D. W. Morgan, G. J. Horne and J. W. C. Judge—and the future of test flying at Supermarines could not be in better hands.

This take-off study of the Swift F.4 leaving Chilbolton gives an excellent impression of the main features of this outstanding Avon-powered fighter.



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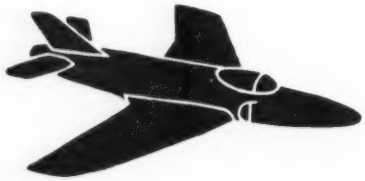

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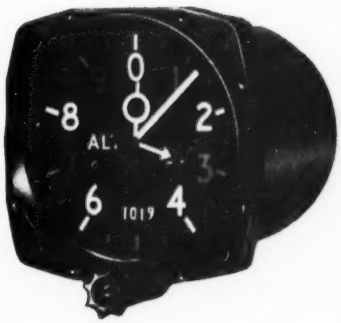
He's just been through the sound barrier



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A short while ago he was testing a supersonic aircraft — doubtless using Smiths instruments designed for high speed flight. Special instruments for development work have always been a major consideration of Smiths, though the organisation is no less concerned with making sound, reliable equipment for everyday flying.

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CIVIL AVIATION

JAN SMUTS AIRPORT, to be formally opened on Sunday, is briefly described in the opening paragraph. A Comet, seen as a speck half-way along the main runway, lends scale to this impressive strip—almost two miles long. New terminal buildings and part of the maintenance area (foreground) are also shown.

SOUTH AFRICA'S MAIN AIRPORT

THE final opening ceremony of Johannesburg's new airport at Kempton Park, on the fringe of the Golden Rand, will be performed by the Minister of Transport, Mr. Paul Sauer, on Sunday, October 4th. Work on the airport—which came into full operational use on September 1st—began six years ago when it was officially named by Field Marshal Viscount Montgomery in commemoration of General Jan Christian Smuts. Ornamental gates bearing Smuts' name were then unveiled.

By far the most ambitious airport in the African continent, the Jan Smuts is situated on a huge flat watershed in the veld, and will cost some £6,200,000 when the administrative and technical buildings are completed. Because of the altitude (6,000ft), the runways are exceptionally long. The main runway, running north/south, is 10,500ft and the two others intersecting it are 8,250ft, all with a uniform width of 200ft, and with overshoot strips.

These international airlines are already using the airport: B.O.A.C., Air France, K.L.M., P.A.W.A., S.A.A., C.A.A., Qantas, El Al, S.A.S. and Deta (Portuguese). Another French airline, U.A.T. is expected to extend its Paris-Brazzaville route to Johannesburg, using Comets. The proving flight has been provisionally fixed for mid-October.

About 1,000 men are employed in the extensive workshops at the airport, where modern repair facilities have been installed. The technical area comprises approximately 9,700ft of tarmac roads, and 885,000 sq ft of concrete apron varying in thickness from 14 to 18in. The hangers have a width of 348ft and are 70ft high. The airport has replaced that at Palmietfontein, about 12 miles distant, which has been closed; a decision about its future has still to be made.

B.E.A.'s ANNUAL REPORT

PROBABLY the frankest and most comprehensive annual report of any airline in the world is that published by British European Airways. The latest edition, announced on Tuesday by Mr. Peter Masefield (in the absence of Lord Douglas, who as British representative was attending a meeting of the executive committee of I.A.T.A. in Montreal) covers the Corporation's activities during the financial year ended March 31st, of which the essential features were a large increase in traffic and a slight increase on last year's deficit of £1.42m.

In 1952-53 B.E.A. flew 1,400,122 passengers—the largest number carried by any airline outside the United States. Of this total 56 per cent, or nearly 1m, flew on international services and the remainder on domestic routes. On the basis of passengers carried, B.E.A. is thus the seventh largest airline in the world.

B.E.A. OPERATING RESULTS SUMMARIZED

	1952-53	1951-52	Percentage change
Revenue	£13,128,080	£10,817,687	+21.4
Operating expenditure	£14,283,724	£12,059,665	+18.4
Operating loss	£1,155,644	£1,241,978	−7.1
Net loss	£1,459,131	£1,423,611	+2.5
Loss as percentage of expenditure	8.1	10.2	−21.4
Capacity ton-miles flown	69,230,611	56,697,971	+22.1
Load ton-miles flown	43,544,039	36,694,775	+18.7
Load factor	62.9	64.7	−2.8
Load factor required to cover total operating cost	68.4	72.1	−5.1
Operating cost per C.T.M.	49.5d	51.1d	−3.1
Traffic revenue per C.T.M.	43.8d	44.2d	−1.4
Traffic revenue per L.T.M.	69.7d	68.3d	+2
Passengers carried	1,400,122	1,135,579	+23.3
Available seat-miles	578,013,390	462,451,642	+25
Revenue passenger-miles flown	372,966,170	309,286,503	+20.6
Passenger load factor	64.5	66.9	−3.6
Mail carried (short tons)	6,289	6,489	−3.1
Mail ton-miles flown	2,541,209	2,451,567	+3.7
Freight carried (short tons)	14,328	12,500	+14.6
Freight ton-miles flown	5,261,659	4,574,243	+15
Revenue hours flown	171,883	153,533	+12
Utilization per aircraft	1,512 hr	1,550 hr	−2.5
Aircraft mile flown	24,202,358	21,594,151	+12.1
Cost per revenue miles flown	141.6d	134.0d	+4.4
Revenue per employee	£1,535	£1,356	+13.2

The average passenger-journey, however, was only 266 statute miles and the average flight-time was 102 min—figures which accentuate the short-haul nature of B.E.A.'s traffic.

The report quotes an interesting comparison of operations by various European airlines in 1951, showing that B.E.A. carried the greatest share of passengers—28 per cent, a proportion which is almost certain to have increased. In that year its passenger traffic was 1.9 times that of its nearest rival (Air France). There remain, however, four important routes on which B.E.A. still carries less than 30 per cent of the traffic offering—those from this country to Switzerland, Scandinavia, Holland and Belgium. The increasingly competitive quality of the Corporation's fleet of aircraft should ensure further gains on all routes. By the end of 1954 the fleet is expected to consist of 20 Elizabethans, 26 Viscounts, 38 Pionairs, 8 Pionair Leopards, 2 Pionair Freighters,

In the twelve-month-period reviewed B.E.A.'s helicopters flew a total of 1,075 hr; the cost of these operations was £79,113, of which £72,133 was payable by the M.C.A. and M.o.S. During the year nine design studies based on the B.E.A. specification for a large helicopter were submitted to the latter Ministry. The report notes that the order for the Rotodyne "was of interest to B.E.A." and that discussions are in progress with the Bristol Aeroplane Co. regarding the Type 181 twin-rotor helicopter seating more than 60 passengers. It mentions delay in delivery of the existing Bristol 173, which will now take place next year. The more powerful Mk 3, which will be much more suitable for initial passenger carrying services, will not be ready until 1958, and the report draws attention to the need for a suitable rotorplane with which to build up experience during this five-year period.

"From the national book-keeping point of view," says the report, B.E.A.'s operations are made to appear less economic than they should by comparison with those of other national airlines. Representations to this effect have been made repeatedly to successive Ministers of Civil Aviation. It will be remembered that in the B.O.A.C. report, published a week earlier, Sir Miles Thomas revealed that the Corporation was asking for Treasury support towards the development of new British aircraft likely to achieve success in overseas markets after the State airline has borne a disproportionate share of introductory costs. To a lesser extent, perhaps, B.E.A. also faces this particular problem: expenditure on Viscount development is estimated at not less than £1m.

B.E.A.'s main heart-cry, however, is that a high proportion of their annual expenditure finds its way back to the Exchequer—in the form of either fuel tax or landing fees. Low mail payments and the burden of maintaining unprofitable social services are additional factors contributing to the adverse picture shown by the annual balance sheet.

At the beginning of last year, fuel tax was increased from 1s 10½d to 2s 6d per gallon and B.E.A.'s contribution of £381,389 was thus £95,530 higher than it would otherwise have been. At 30d per gallon, the British domestic fuel tax is exceeded only in France and Belgium (where mitigating circumstances exist), and compares with an average rate of 5d in the United States. The average fee paid for each B.E.A. aircraft landing in this country was £4.1, compared with £3.5 on the Continent; the corresponding U.S. average is £1.3. Although short-haul services are now basically more expensive to operate than long routes, B.E.A.'s mail rate per tonne-km of 108d is 26d less than that paid to B.O.A.C. and, to quote a typical American operator, 67d below the rate received by Northwest Airlines. Regarding social services, the report says that the amount required to cover the costs incurred by their operation, including overheads, would be in the region of £300,000.

These considerations apart, B.E.A.'s operations during the year reviewed were affected by other factors completely outside the

CIVIL AVIATION . . .

airline's control. The £25 reduction on the foreign travel allowance is estimated to have cut down revenue by £900,000. Shortage of fuel during the American strike resulted in the cancellation of 1,554 services and the loss of a further £300,000.

Both B.E.A. and B.O.A.C. suffered as a result of last winter's long foggy spell, and both favour the installation of Fido, in improved form, at London Airport. The M.C.A. is considering a proposal to this effect.

THE AIRLINES' PARLIAMENT

SOME 200 delegates, representing most of the 67 member airlines, are attending the ninth annual meeting of I.A.T.A., which begins next Monday at the Windsor Hotel, Montreal, and continues until October 9th. At the opening session the president of T.C.A., Mr. Gordon McGregor, will take over from Dr. Berchtold of Swissair as the new president. As in previous years, the meeting will begin with the annual report of the director-general, Sir William Hildred, followed by the reports of the various standing committees, and will end with a public session at which next year's president will be elected.

Britain will be represented by Lord Douglas of Kirtleside, Mr. G. A. Boughton, Mr. P. C. F. Lawton and Miss J. P. Hooper of B.E.A., and by Sir Miles Thomas, Major J. R. McCrindle, Air Marshal Sir Harold Whittingham, Mr. B. Smallpiece and Mr. K. H. Staple of B.O.A.C.

ANNIVERSARIES IN AUSTRALIA

TWO important anniversaries were celebrated last month in Australia. Twenty-five years earlier Sir Charles Kingsford-Smith made the first air crossing of the Tasman Sea, covering the 1,600 mile journey in just under 16 hours in *Southern Cross*. A regular passenger service was inaugurated nearly twelve years later by Tasman Empire Airways, who have since made nearly 8,000 crossings of the Tasman, carrying over two million passengers. The airline's Solents now make 11 flights weekly on this route and there is also a fortnightly charter service between Melbourne and Christchurch by a DC-4 of Qantas. This company last month commemorated a more recent but significant event—the opening, a year ago, of the Indian Ocean service between Sydney and Johannesburg *via* Perth, Cocos and Mauritius. In the first year of operation the Constellations made 28 return flights, with 2,000 passengers, 43 tons cargo and 10 tons mail.

Nukualofa, principal island of the Tonga group (whose monarch, Queen Salote, visited this country for the Coronation) now has its first air service. Regular flights are made by Solents of Tasman Empire Airways from Suva, thus linking the islands with Tasman's Coral Route to New Zealand and with the Qantas service to Australia.

SILVER CITY PROFITS PUBLISHED

LAST week Silver City Airways, Ltd., published its annual trading results. The chairman, Mr. E. C. Mekie, disclosed that in the year ended December 31st, 1952, there was a net profit after taxation of £35,094, against £48,478 the year before. The factor behind the profit decline, he said, was the reduction of the personal travel allowance in January 1952. This year's enormous increase in cross-Channel ferry traffic is largely the result of substantial reductions in fares, and profits for 1953 are therefore not expected to rise proportionately.

LOCKHEED AND JET TRAVEL

SPEAKING at Bonn, Germany, last week, Mr. Hall Hibbard, Lockheed vice-president, predicted that both his company and Douglas would announce their "Comet-killers" within four to six months. They would, he said, be bigger and faster than anything flying today, and above all they would be money-makers. A large part of his speech was on the now-familiar theme of damning the Comet with faint praise.

Now that fighting has ended in Korea, Lockheed, Douglas and Boeing are all certain to have intensified their efforts to produce jet airliners acceptable not only to American operators but to a world market. The form they will assume is still the subject of bluff and surmise. While it cannot be confirmed, the following report on one of these designs is thought to be authentic.

The Lockheed prototype now reported to be under construction is said to feature thin wings with 50 deg of sweepback and a swept single fin with high-set tailplane. The passenger cabin, with capacity for 120 people in the tourist version, is situated entirely forward of the trailing-edge of the wing. Immediately behind the wing are mounted four turbojets—two on each side of the fuselage, the upper units being placed forward of those beneath. The object of such a layout would presumably be to overcome the disadvantages of both buried and podded engines, and to keep the passenger compartment as silent as possible. Unlike the twin-jet French Caravelle, which also has fuselage-mounted jets, the power units on the Lockheed protoype are said to have wing-root instead of direct, ram-type air intakes. Cruising performance is estimated as 550 m.p.h. at 42,000ft.

DC-6Bs FOR A.N.A.

AN order for four Douglas DC-6Bs is announced by Australian National Airways, whose state-owned competitor (T.A.A.) is to have Viscounts next year. At present operating a fleet of DC-3s and DC-4s, A.N.A. expect to receive two of their new Douglas airliners before Christmas; the other two will not be delivered until January 1955. Between July 1946 and June this year, the company's aircraft flew nearly 1,235,000 hr, carrying 4½m passengers and some 180,000 tons of freight.

NEW TOURIST ROUTES

DURING the first week of October B.O.A.C. and other I.A.T.A. airlines will begin extension of tourist travel to nine new areas—India, Parkistan, Ceylon, the Persian Gulf, the West Indies and North, West, Central and South Africa. On most of B.O.A.C.'s routes the new services will be operated by 54-seat Argonouts. Some typical examples of reduced return fares (at least 20 per cent below first-class rates) are London-Bombay, £216, compared with £293 8s; London-Johannesburg, £252 (the first-class fare, for Comet passengers only, is £324); and London-Lagos, £169 4s, a reduction of £44.

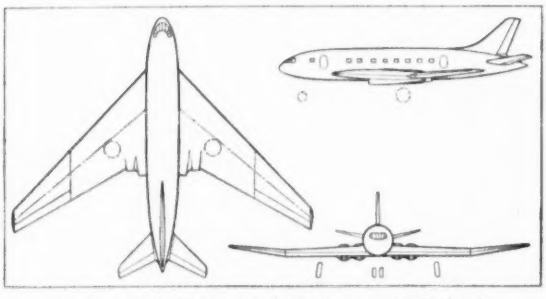
CIVIL PACKET DEVELOPMENT

WITH a view to determining whether the Fairchild C-82 Packet would be suitable for civil operators carrying cargo under military contract, the U.S.A.F. is reported to have sponsored manufacturer's flight tests for possible C.A.A. certification. Modifications to the aircraft include removal of several thousand pounds of fittings, including troop seats, monorail equipment for cargo dropping and special U.S.A.F. radio and navigational equipment. The Flying Tiger Line is described as the main potential customer for civil C-82s, 220 of which were built for the U.S.A.F.

COMET CHRONOLOGY

THE story of the Comet's development and introduction was told recently by Mr. A. C. Campbell Orde, whose lecture (summarized on page 489 of this issue) included a chronology and illustration (below) of the aircraft as ordered in May, 1946. Wing sweep was 40 deg, later modified to 20 deg, and the estimated cruising Mach number would have been 0.87, compared with 0.74 for the production Comet 1; payload, however, was only 7,500 lb, compared with 11,800 lb.

July 3rd 1944	B.O.A.C. endorsed Brabazon Committee outline requirements for "Type IV" of about 30,000 lb with two or more simple jet units, range 700-800 miles, payload 3,000 lb including 14 passengers.
October 1945	De Havilland submitted proposals for design suitable for "Empire" or North Atlantic. This was the original D.H.106 with four 5,000 lb Ghost engines, 40 deg sweepback and all-up weight of 82,000 lb.
January 1946	B.O.A.C. formally requested the Ministries to order eight D.H.106 aircraft on its behalf, on the firm's preliminary estimates.
May 1946	First brochure issued by de Havilland.
September 1946	Ministry of Supply ordered two D.H.106 prototypes.
October 1946	B.O.A.C. agreed de Havilland proposal to revise design, reducing sweepback to 20 deg and lengthening the fuselage for greater payload capacity.
January 21st 1947	"Instruction to Proceed" with eight aircraft formally issued to firm by Ministry of Supply on behalf of B.O.A.C. This was based on proposals defined and agreed in October 1946.
November 1948	Agreement with the firm to replace the single-wheel undercarriage with a four-wheel bogie was reached.
July 27th 1949	First flight of first prototype.
March 22nd-October 24th 1952	Loan by Ministry of Supply to B.O.A.C. of second prototype for development flying.
January-May 1952	Training and route survey flights.
February 4th 1952	B.O.A.C.'s first aircraft delivered.
May 1952	U.K./South Africa service opened.



A Comet with 40 deg sweepback (see paragraph above).

Co-operation that has made History

THE CLOSE ASSOCIATION

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Vickers Supermarine and Rolls-Royce

has produced such famous aeroplanes

as the Schneider Trophy S.6,

the Merlin powered Spitfire and

the Swift powered by the

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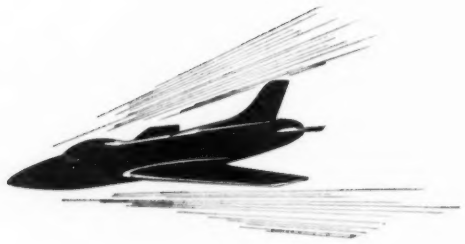

INFINITELY SWIFT is the flight of time
as they see who look back at it
SENECA

Congratulations, Supermarine

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CIVIL AVIATION . . .

LONDON-NEWCASTLE FARE REDUCTIONS

PERIOD fare concessions have been recently introduced by Hunting Air Transport, Ltd., on their services between Newcastle and London. An eight-day return fare is now £6 5s, and a 30-day return fare £6 15s, compared with the normal 12-month return fare of £7 4s. The single fare for the journey is £4.

By transferring their London Air Terminal for airport coach arrivals and departures to 5, Fitzhardinge Street, Portman Square, from the Waterloo Air Terminal, Huntings have cut down their city-to-airport times, and the London-Newcastle service now provides a time-saving of almost two hours on this journey compared with the best times by surface transport.

AUSTRALIAN MERGER

NEGOTIATIONS have been completed betwen East-West Airlines, Tamworth, N.S.W., and South Coast Airways, Sydney, for the merger of the two companies. Under the terms of the agreement South Coast Airways has become a subsidiary company of East-West Airlines, and its policy, administration and operations are controlled and executed from East-West Airlines' head office at Tamworth.

Capt. A. J. Smith, general manager of East-West Airlines, said recently that the company expected to open up an additional 1,500 miles of unduplicated air routes within New South Wales and Southern Queensland during the next two years.

On the new schedules now being flown, the company's aircraft will cover 17,000 route miles and provide 1,427 passenger seats on 76 scheduled flights each week.

BREVITIES

JAPAN will become the 61st member nation of the International Civil Aviation Organization on October 8th.

* * *

The M.C.A. announce the appointment of Mr. G. McD. Wilson as "alternate delegate" to the U.K. representative on the council of I.C.A.O. A war-time lieutenant in the Fleet Air Arm, Mr. Wilson succeeds Mr. I. V. Pugh. He took up his appointment on September 29th.

* * *

Trans-Australia Airlines last month celebrated the seventh anniversary of their inaugural service—from Melbourne to Sydney. Since then, the airline has carried over 3½m passengers without a fatal accident, and has lifted 75,000 tons of freight and 11,000 tons of mail.

* * *

August was the second successive month in which Central African Airways have made a clear (net) profit. The August profit was £15,000 and that for July was £11,900. Extra traffic resulting from the highly successful Rhodes Centenary Exhibition was largely responsible for these improved results.

* * *

The first of two Douglas DC-6A all-freight aircraft ordered by Canadian Pacific Airlines was delivered to Montreal on September 22nd. It is intended to be used on a new cargo service between Montreal, Toronto and Vancouver. The company's application to operate this route was opposed by T.C.A. and has not yet been approved by the Canadian government; it is reported that, if the application is rejected, the aircraft might be sold abroad.

Lord Douglas of Kirtleside, chairman of B.E.A., and the members of the board, visited Holland on September 18th-19th at the invitation of K.L.M. They inspected Schiphol Airport and the head office of the Dutch airline at The Hague.

* * *

Accidents involving civil aircraft in New Zealand totalled 93 last year, compared with 108 in 1951-52. Both N.Z.N.A.C. and T.E.A.L. completed their fourth successive accident-free year, and for the first time since the end of the last war flying clubs suffered no fatal accidents. There were 49 accidents in agricultural flying, causing the deaths of two people.

* * *

Approval to operate, subject to the customary conditions, an all-freight service between London and Belgrade *via* Cologne, Munich and Zagreb has been granted to Eagle Aviation, Ltd. The licence is valid until September 30th, 1960. B.O.A.C. have received approval to operate, until April 3rd next, a normal scheduled service on the route Calcutta-Delhi-Karachi-Behrein-Baghdad-Beirut-Rome-Dusseldorf-London (westbound only).

* * *

Both State-owned and independent operators experienced increases in traffic during April and May. B.O.A.C. carried 21,000 passengers in April and 28,000 in May, increases of 12.9 per cent and 25.9 per cent respectively. B.E.A.'s passenger traffic in April amounted to 127,000 (an increase of 37.3 per cent) and the percentage increase for May, when 141,000 passengers were carried, was 31.6 per cent. Associated companies, carrying 8,000 in April and 13,000 in May, achieved increases of, respectively, 131.9 and 125.6 per cent. Independent freight traffic increased by over 200 per cent in both months.

FROM THE CLUBS

NEXT Sunday, October 4th, Luton Flying Club are staging a tea patrol. The usual rules will apply, and occupants of aircraft pentrating the defences between 3 and 4 p.m. will win free teas. There will be an individual prize for the owner of an aircraft landing at a sealed time between these hours.

OWNERS and operators of Gemini 1As who have found it impossible to obtain a copy of the maintenance schedule for their aircraft will be glad to know that copies can now be obtained from W. S. Shackleton, Ltd., 175, Piccadilly, London, W.1. The company tells us that, after diligent inquiry, it found that there were apparently only two copies of the schedule available in this country, one of which it acquired. Duplicated copies have now been run off and can be supplied at 30s.

INVESTIGATIONS by the manufacturers have shown that instances of defective crankshafts in Blackburn Cirrus Minor 2 engines, reported from certain countries, are possibly due to failure to observe the limitations concerning the minimum octane rating of the fuel and/or the minimum take-off r.p.m. As a precautionary measure, the A.R.B. has directed that all Cirrus Minor 2 crankshafts which have completed 600 hours' running since the last Magnaflux check shall be re-checked on a Magnaflux test machine as soon as possible, and thereafter re-checked at periods not exceeding 600 hours.

In order that the above restrictions may be relaxed, the company has decided to introduce a modified crankcase top cover, with new intermediate bearing caps bolted through the cover, thus stiffening the crankcase. Engines fitted with a modified top cover will not thereafter be subject to the Magnaflux test until complete overhaul at 800 hours.

Private owners and clubs may arrange for Magnaflux testing of crankshafts to be carried out at the Blackburn factory at Brough, by contacting the engine servicing manager.

WHAT is thought to have been the first air rally ever held by a private British firm was staged at Bembridge, I.o.W., on Saturday, September 19th, by employees of Smiths Aircraft Instruments, Ltd., and Kelvin and Hughes, Ltd. Altogether seven aircraft took part (five Austers, one Chipmunk and a Miles Monarch), carrying 19 members of the two firms from as far apart as Denham, Cheltenham and Panshanger. Smiths' flying club, formed only 18 months ago, now boasts 32 members, most of whom have reached solo stage; seven have gained P.P.L.s. By actively participating in private flying, members of the two aircraft instrument firms obviously acquire a good deal of experience which provides a useful background to their work. It is unfortunate that so few companies in the aircraft industry have yet taken advantage of the firms' flying club scheme.

DIRECTOR and chief flying instructor of Tollerton Aero Club, Ltd., and Nottingham Flying Club, Captain Lewis Wigham Hall, of the Old Rectory, Tollerton, died on August 29th at the age of 60. He was formerly managing director of Nottingham Airport, Ltd., and had been ill for some time. He was seconded from the Border Regiment in the first World War to the R.F.C., left the Army in 1928, acquired an interest in Tollerton Aerodrome, and subsequently became managing director. He joined the R.A.F. in 1939, and served in Airfield Control.

R.Ae.C. PILOT'S CERTIFICATES ISSUED, AUGUST

No.	Name	Cl.	No.	Name	Cl.
28,506	Miss R. M. Sharpe	1	28,512	R. Bradley ...	2
28,507	C. D. Weiswall ...	3	28,513	P. Wannop ...	2
28,508	W. P. Warner ...	3	28,514	F. W. Frost ...	4
28,509	D. F. Todd ...	1	28,515	F. W. Haines ...	4
28,510	J. G. Soper ...	4	28,516	J. H. Denyer ...	1
28,511	P. W. Ball ...	4	28,517	F. V. Davico ...	1

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News

Tour by Deputy C.A.S.

DEPUTY CHIEF of the Air Staff, and Vice-Chief of the Air Staff designate, Air Marshal Sir Ronald Ivelaw-Chapman, was due to leave London on September 29th for discussions with Commonwealth Air Force authorities in New Zealand and Australia. He will pay a short visit to Ceylon on the outward journey, and, when he is in New Zealand, will see the end of the London-Christchurch Air Race. On the return journey he will visit R.A.F. units in the Far East and Middle East, and will call to see the Commander-in-Chief of the Indian Air Force and the Commander-in-Chief of the Royal Pakistan Air Force.

The tour will involve flying about 25,000 miles in a Hastings of No. 24 (Commonwealth) Squadron, R.A.F. Transport Command. Sir Ronald, in addition to his discussions with officers of Commonwealth Air Forces, plans to visit isolated units of the Middle East Air Force and the Far East Air Force where small R.A.F. detachments are stationed. Among these will be staging posts for the R.A.F. Valiant and Canberras competing in the New Zealand Air Race at Negombo (Ceylon), the Cocos Islands and Perth (Western Australia). On the return journey he will visit such small and little-known R.A.F. detachments as those at Car Nicobar, in the Indian Ocean, and Mesirah, off the South Arabia coast. He is due to return on November 4th.

Technical Cadets Graduate

A PASSING-OUT parade at Henlow on Friday last, September 25th, marked the completion of the first phase of the new scheme for training technical cadets for the Royal Air Force. Last October the first entries of Technical Cadets (University) went to the R.A.F. Technical College, Henlow, and Friday's parade marked the graduation of 20 candidates. The reviewing officer was Air Chief Marshal Sir John Whitworth Jones, Air Member for Supply and Organization. At the time when the new scheme was being considered Sir John was A.O.C.-in-C. Technical Training Command. The prize winners were: Tech.Cdt. D. J. Pugh—**The Norton Sword and Science Prize.** Tech-Cdt. C. A. Cooper—**The Franks Trophy.** Tech.Cdt. J. K. Pettifer—**Mathematics Prize.**

In his address at the graduation ceremony the Commandant, A. Cdre. H. D. Spreckley, gave details of the cadets further training. Of the 31 cadets reviewed, 11 stay at Henlow for a further two years training and the other 20 go to Universities for three years to qualify for an honours degree in engineering. At the end of the three years they return to Henlow for six months to familiarize themselves with the actual equipment with which they will be dealing in the Service. While they are at the Universities, reports from their tutors, and from the commanding officers of the University Air Squadrons, will be sent to the Commandant.

A. Cdre. Spreckley also emphasized that one of the aims was to prepare the University cadets for qualifying examinations for the Mechanical Sciences Tripos of the University of Cambridge. In this the college had been very successful, resulting in 17 cadets passing with high marks.

Air Chief Marshal Sir John Whitworth Jones in his address referred to the complexity of the world's material civilization and went on to say: "British engineers and scientists are rightly acclaimed for their pre-eminence in the fie'd of basic research and the ability to see how the results of such research can be turned to practical use. Our craftsmen are famous for their skill. These qualities enable us to set very high standards in engineering and point the way to further advances. They do not, however, enable us to fill the ever-changing needs of vast and growing demand of a mechanized world. For this we need some numbers of very high-grade technicians and production and maintenance engineers. This is a field in which our American friends excel, so I make no apology for borrowing an American phrase to describe them as the 'know how' men. This country urgently needs many more 'know how' men."

Sir John then went to great length to show the subtle difference between a good technician and a good technical officer, pointing out the need for an officer not only to have high technical ability, but also to have great qualities of leadership and desire to serve others as well.

New R.O.C. Commandant

ON relinquishing his post as S.A.S.O. No. 22 Group, Technical Training Command next March, A. Cdre. J. H. T. Simpson, D.C.O., A.F.C., is to become Commandant of the Royal Observer Corps.

A. Cdre. Simpson entered the R.A.F. in 1927, with a short-service commission. Most of his wartime service was in the Middle East, where he commanded No. 70 Squadron and No. 236 Wing. He became S.A.S.O. to, and later A.O.C. No. 205 Group.

No. 600 Squadron Association

IT has been decided to form an association for past and present members of No. 600 (City of London) Squadron, R.Aux.A.F., of which the Queen Mother is the Honorary Air Commodore.

A general meeting has been convened for today, Friday, October 2nd, at Finsbury Barracks, City Road, E.C.1, at 7.30 p.m. The bar will open from 6 p.m. to give old friends an opportunity for an informal chat before the formal meeting. G/C. P. G. Stewart, one of the very early members of the squadron, is chairman of the existing committee.

The R.A.F. Quarterly

STARTING with the issue for October, the *R.A.F. Quarterly and Commonwealth Air Forces Journal* will in future bear the title *Air Power, The Air Forces Quarterly*. The change has been made in view of the much extended field of the subject matter.

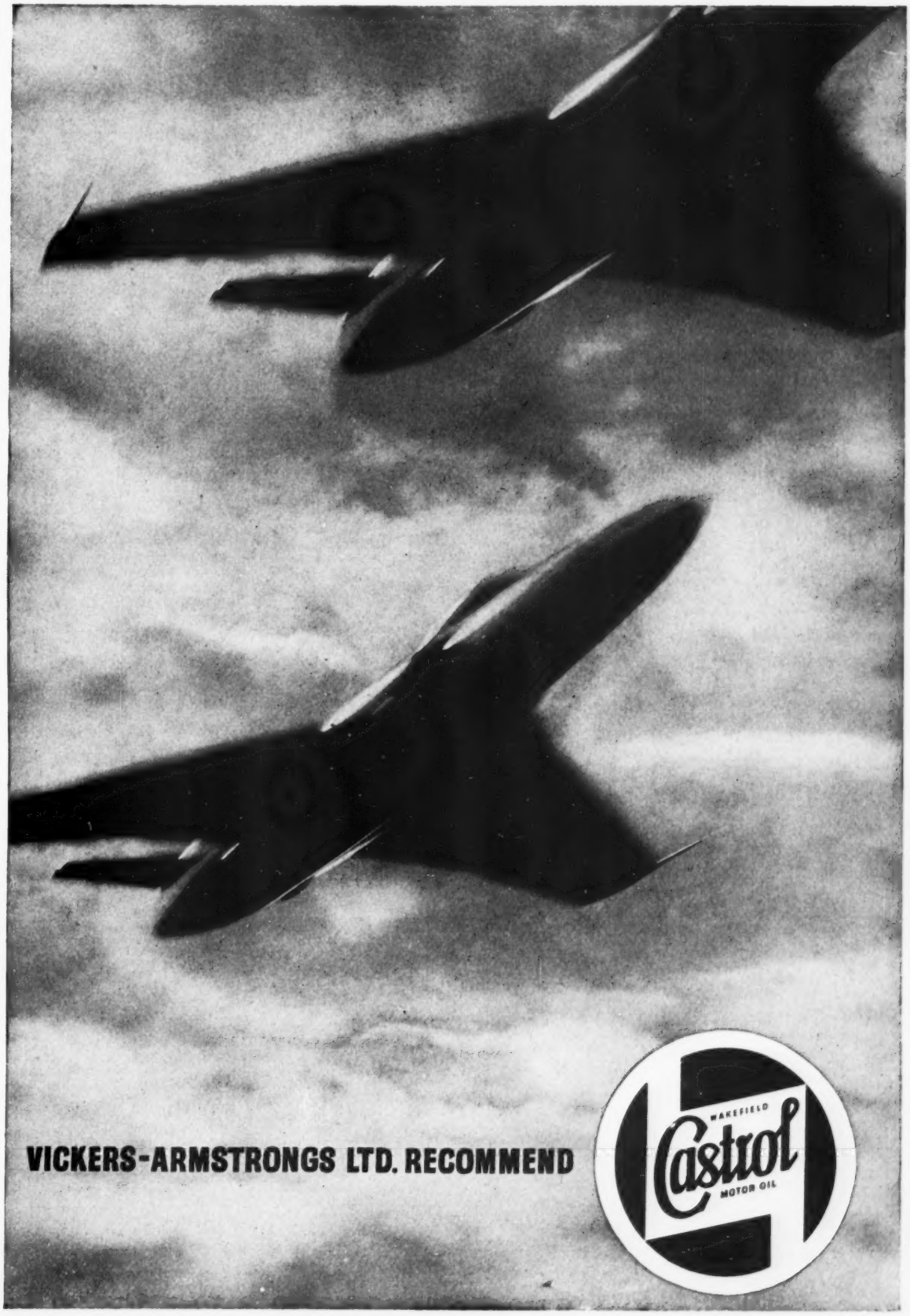
Reunions

THE reunion of No. 164 Squadron is being held on Saturday, October 24th, at the "Rose and Crown," Sloane Street, London, S.W.1, at 6.30 p.m. Particulars from L. Plows, 8 Talbot Road, Bayswater, London, W.2.

We are requested to warn all ex-members of No. 69 Squadron to stand by for a reunion to take place in London on the second or third Saturday in November.

The eighth annual reunion of No. 85 Squadron will be held at the Ambassadors Hotel, London, on Saturday, November 7th. Tickets, 17s 6d each, from J. Roberts, 14 Carisbrook Close, Enfield, Middlesex.

TECHNICAL GRADUATION: Below, Air Chief Marshal Sir John Whitworth Jones inspecting the cadets at last Friday's passing-out parade at Henlow and, on the right, handing the Norton Sword to Tech.Cdt. D. J. Pugh. Top right are two more prize winners, Tech.Cdt. C. A. Cooper and Tech.Cdt. J. K. Pettifer. "Flight" photographs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The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

Air Speed or Mach Number

A WORLD air speed record that is dependent on temperature is clearly misleading.

Is it not possible to correct air speeds to a standard set of atmospheric conditions?

Air speed records, thus corrected, would be truly comparable whether made at Muroc, Castel Idris or Shoreham-by-Sea.

Kingsley Green Haslemere. P. H. W. RUSSELL, Lt.-Col. late Royal Artillery.

Bravado

I HAVE just read in the paper that S/L. Bill Waterton got "a terrific rocket" for pointing the Javelin at the crowd during his demonstration. Whilst sympathizing with the S.B.A.C. Flying Committee, I feel that in order to see our aircraft at their best—and that is what we want—they must be pointed at the crowd unless we are to be limited to a display of flying that is not all it might be.

I am quite prepared to see an aircraft flying over my head, and I am sure that many others are. The accident at last year's display was a great tragedy, but I don't think that there is any need to handicap the pilots any more than they are already. I was within 15 ft of the "hole in the crowd" last year and I think that if anyone should be against flying near the crowd it should be me.

Old Coulsdon, Surrey. D. J. WEAVER.

£ s d and Private Flying

IN his article, "Flying for Sport," contained in the 18th September issue of *Flight*, Mr. Ogilvy laments the apathy prevalent in this country. I had to permit myself a hollow laugh when he discarded the obvious answer, that lack of funds is the root of the trouble.

Before Hitler started the recent fracas I could and did, fly with the C.A.G. at the very modest fee of 5s. per hour. Now I and a number of my friends and colleagues who were, like myself, wartime pilots would dearly love to take to the air again. Despite the existence of the Popular Flying Association and sundry schemes for cheap flying we just haven't the spare cash now that all of us are married, the majority with families and, of course, a house of our own which has to be paid for through the years as we haven't the capital to buy outright.

I am in no position to contend Mr. Ogilvy's excellent article other than as above, but if what he writes is indeed the state of affairs among those more fortunate flying types, then the position really looks black. I can't believe it can be quite as bad as it seems, however.

Mansewood, Glasgow, S.3. R. A. FORBES.

No Heliport at L.A.P.

I HAVE noticed that in the Ministry of Civil Aviation's recently published plans for the development of London Airport there is no reference whatsoever to helicopters, and no apparent provision has been made for a helicopter landing area.

Since B.E.A.'s helicopters have been calling daily at London Airport for a considerable time, the reasons for this significant omission seem hard to understand. In Europe and the United States many airports have already been provided with a special helicopter park, usually near the terminal buildings, and many more have been projected.

If passenger-carrying helicopters are to take their rightful place in the field of air transportation, surely some thought should be given now to the provision of facilities whereby helicopter passengers from provincial cities may be transferred rapidly to air liners flying the trunk air routes, and vice-versa.

Apart from its special application to short-haul inter-city communication, it is the essence of a passenger helicopter's utility that it should work as an adjunct to fixed wing aircraft. To enable it to perform this function in the most efficient manner a suitably designed parking area should be located as near to the passenger embarkation points as possible.

It is to be hoped that this omission does not reflect an official view that the requirements of helicopters are not worthy of consideration.

Bromley, Kent. BASIL ARKELL.

[This query was raised at the Press conference called to announce the development plans for London Airport. The M.C.A. took the line that not enough was known about the pattern of future helicopter services to incorporate cut-and-dried plans for a helicopter landing-site, but that ample space would be available when the need arose.—ED.]

Battle of Britain Credit

WHEN this country was at the cross roads and eventually won the Battle of Britain our allies consisted of the Commonwealth and those few who were lucky to escape from the Continent. At that time the U.S.A. was a neutral, so why should she take part in the anniversary fly-past?

This letter is not intended to antagonize our American friends, but rather to draw attention to the fact that if the U.S.A.F. takes part in the parade each year then the time will come when those in the States who are not so well informed, will think that they also won the Battle of Britain, which after all was the most important battle of the war.

It is interesting to speculate on what would happen if we took part in the Independence Day celebrations.

Pinner, Middlesex. W. B. HOLROYD, F/Lt.

[We should not forget that American volunteers in the Eagle Squadron took part in the Battle of Britain.—ED.]

Airline and Transport Command Pilots

I IMAGINE that F/O. L. H. Levene has started something with his letter (August 28th) on M.C.A. examinations, and civil airline standards *versus* those of Transport Command.

I think a large number of pilots employed in civil aviation will agree with his remarks on academic qualifications. I would like to point out, however, that many of us start our careers with only the Junior Commercial Licence, which is a reasonably practical and straightforward examination. The main difficulty is to continue line-flying and at the same time to study and convert to either the Senior Commercial Licence or A.L.T.P. This, I believe, is where some rearrangement is essential, possibly by M.C.A., allowing two subjects to be taken at a time, the whole syllabus being covered in a year.

London, W.4. 2ND OFFICER.

The Last Wimpy

I WOULD like to draw your attention to the article "The Last Wimpy" (Service Aviation, *Flight*, September 18th, 1953), and in particular to the two references regarding the date of the Wellington's last operation. It is specified once as March 1945, and then again as March 13th, 1945, and yet I carried out an anti-submarine patrol off the Hague on May 2nd, 1945, in a Wellington 13 (for which I was credited with half an operation).

My last night operation was on April 12th, 1945, also on a Wellington 13, and was a low-level night recce. of the Dutch causeway and the ferries at Stavoren and Enkuizen. Both these flights were carried out after March 1945, and I have no doubt whatever that even later operations were executed by 69 Squadron. We were attached to No. 34 Wing, 2nd T.A.F. (apparently forgotten long ago) and engaged on the soul-destroying and dicey job of low-level night photographic and visual reconnaissance (except on moonlight nights, and then we were bombed up for any odd targets reserved for such occasions).

This letter I think should help to establish that the "Wimpy" was in at the start of the air war and still there operating at the finish. What a fine record for the grand old lady of the air!

Now a further complaint about official figures. At the recent preview of the film "Appointment in London" the official souvenir programme stated that the last Lancaster raid was a daylight raid on Hitler's eagle nest on April 25th, 1945, but from a friend I understand that he was on a Lancaster raid carried out during the night of April 25th/26th. This may be only 12 hours later but it does give rise to the question "Are there any later still that have been missed?"

London, S.E.14. J. SWIFT.

FORTHCOMING EVENTS

Oct. 3. Helicopter Association: "Problems of Helicopter Operation Peculiar to Shipboard Use," by Lt.-Cdr. H. R. Spedding, R.N.; "Helicopters and the Whaling Industry," by A. E. Bristow.
Oct. 5-9. I.A.T.A. Annual General Meeting, Montreal.
Oct. 7. R.Ae.S. (Bristol): "Flutter", by Prof. W. J. Duncan.
Oct. 8. London Airport: Start of England-Christchurch (N.Z.) Air Race.
Oct. 9. Airlines Ball, Royal Albert Hall, London.
Oct. 13. R.Ae.S. Section Lecture: "Use of Materials in the Plastics Range," by H. L. Cox, M.A., F.R.Ae.S.
Oct. 21. R.Ae.S. (Manchester): "Some aspects of high-speed jet aircraft," by S/L. W. A. Waterton.
Oct. 23. Aerauto Association: Annual Dinner and Dance, Westminster Arms, Page Street, London, S.W.1.
Oct. 23. R.Ae.S. (Birmingham): "Helicopters."
Oct. 28-30. Institute of Welding: Annual Dinner and London Autumn Meeting.

THE ANGLO-AMERICAN CONFERENCE

IT is generally agreed that the recent Anglo-American conference held by the Royal Aeronautical Society and the Institute of the Aeronautical Sciences was not only the largest, but the most useful of the four meetings which have so far been held. In our last issue we published summaries of the first three lectures, together with the ensuing discussions. On this page, and the four following, are similar shortened versions of the remaining nine lectures and discussions, together with a page of specially commissioned sketches of some of the well-known personalities who attended the conference.

SOME FACTORS AFFECTING HELICOPTER DESIGN AND FUTURE OPERATIONS

By R. H. MILLER

(Vice-president engineering, Kaman Aircraft Corporation)

THE major design effort of the helicopter industry, said Mr. Miller, was at present directed towards (a) increasing cruising speed; (b) simplification of power plant and drive system; (c) establishing fatigue criteria for structural components and (d) improving handling qualities. He proceeded to discuss under these headings some design problems associated with various rotor systems.

Speed.—The immediate commercial application of the passenger-carrying helicopter would probably be as a replacement for surface rather than air travel: whether an increase in cruising speed was necessary or desirable in view of the weight and power penalties involved was, in the author's view, open to question. An obvious means of decreasing the power consumption at high speeds was to add the more efficient fixed-wing lifting surface for forward flight and to use the rotor mainly for hovering and at low forward speeds. For a cruising speed of 180 m.p.h. a conventional helicopter requiring twice the rotor blade area and a 50 per cent increase in power would be 16 per cent heavier; with a wing carrying half the gross weight, it would be 9.4 per cent heavier.

A logical next step was the addition of a propeller together with a clutch, since it would be undesirable to absorb power in the propellers during hovering flight. Some of the convertiplane's weight margin could be retained by operating the rotor in the autorotative regime and slowing it down appreciably, but this introduced instability problems.

Evaluation of the mechanically complex system involving the tilting of the main power drive through 90 deg, to enable rotors to be used as propellers in forward flight, would have to await the results of detailed design and flight tests.

Another approach was to eliminate the cause of the high-speed limitation by avoiding stall on the retreating blade. Use of a rigid non-flapping rotor would evidently allow control of blade angles at all azimuth positions; in practice, however, a sufficiently rigid blade could not be achieved without a prohibitive weight penalty. Mr. Miller then outlined another method of achieving the effects of a rigid rotor without eliminating the hinge—the "offset flapping hinge," discovered during recent wind-tunnel tests at Massachusetts Institute of Technology.

Also capable of relatively high forward speeds was the supersonic rotor, which, in view of increased emphasis on light, high-strength alloys, might become of interest in the near future.

Power Plants.—The operational success of a helicopter transport would depend, in the final analysis, on the cost per ton-mile, which in turn was dependent on a minimum empty weight. An obvious area of potential weight reduction was the rotor drive assembly. The weight factor had given impetus to the development of self-driven jet rotors, despite their present high specific fuel consumption. In general, because of high fuel consumption, complexity in blade design to allow for air passages, and limited weight saving, it was probable that pressure or hot-gas jet rotors would not be used for general transport.

The gas turbine engine with secondary free-wheeling turbine to supply shaft power to the rotor, eliminating the necessity for a clutch, provided the variable rotor-speed characteristics so desirable for helicopter application. It also offered reduced noise, mechanical simplicity, increased transmission life, greater compactness, absence of any major cooling problem and a power saving of approximately 5 per cent. Of major importance to the helicopter designer was the weight saving possible with a turbine installation. A table summarizing weight/range characteristics of helicopters with the various forms of power discussed showed that the gas turbine helicopter was superior to the reciprocating version for flights of up to 4 hours duration.

Fatigue.—With the rotor and drive system representing 20 per cent of gross weight, there was a major temptation to reduce this percentage by structural refinement and higher operating stresses in these critical components. However, design to fatigue criteria was customary for all rotating parts. It was possible that the rotor with more rigid blades would operate at lower stresses and vibratory levels and hence more smoothly than the conventional rotor with highly flexible blades.

Stability and Control.—In the lecturer's view, stability was not quite the problem it had been made out to be. Commercial operations would eventually require a degree of inherent stability and control sensitivity which had only been achieved so far with autopilots. To use the rotor itself as the gyroscopic stabilizing element (a type of stabilization which might be incorporated with only minor modifications to a conventional rotor system) would be a safeguard against dangerous divergence in the event of failure of the automatic control equipment. Experience to date had indicated that the autopilot should be permanently engaged and incorporated in such a way as to permit the pilot to manoeuvre through the regular controls and not through a separate system.

Discussion.—In the discussion which followed Mr. Miller's lecture, several British helicopter authorities paid tribute to his expressive summary of the written paper and his grasp of the wide field it covered. DR. RAOUL HAFNER, speaking with experience of the newly modified Bristol 173, added a note on the value of stub wings, now carrying a third of this big helicopter's designed a.u.w.; vibration had been reduced and dynamic stability improved. Bristol's agreed with Mr. Miller's assessment of the free turbine for helicopters. DR. HISLOP, Fairey's chief designer (helicopters), affirmed that speed could not be neglected; the airlines could not achieve regularity without machines faster than those now available. What was the answer to the noise problem with supersonic rotors? Mr. Miller did not know, but thought there might be one by the time all the other problems had been overcome. Some pilot's requirements listed by W/C. R. A. C. BRIE included a vertical ascent of not less than 1,000ft/min in still air at a.u.w., and a power-off descent of not more than 1,000ft/min under the same conditions, and an accurate A.S.I. for speeds of 10-40 m.p.h. He felt that undercarriages added unnecessary weight; commercial helicopters would land on mobile platforms. MR. ROBERTSON (Short's) declared that design problems would be best overcome by intensive development of the simple basic layout, and welcomed those parts of the lecture which encouraged this viewpoint.

THE FATIGUE OF AEROPLANE STRUCTURES

By RICHARD V. RHODE

(Assistant Director for Research, National Advisory Committee for Aeronautics)

THE problem of fatigue in aircraft structures, began Mr. Rhode, involved two elements; firstly, the start of a fatigue crack during the useful life of the machine and, secondly, the undetected growth of the crack until the structure could no longer support the normal operating loads.

A study of design-trends indicated that no detrimental change in the fatigue lift of transport aircraft could be ascribed to the combined effects of decreased load factors, increased speed, or increased wing loading. Indeed, the contrary appeared to be true. The same statement could be made also with respect to the effect on fatigue life of an increase in the mean stress, insofar as this increase had been brought about by an increase in the wing loading. In fact, the effects of the trends in load-factor, speed, and wing-loading appeared to permit an increase in design stress without a deterioration in the fatigue life.

With respect to the effects of aircraft size, the lecturer continued, the trends in natural wing frequency, the increased scale of the gust gradient distance and the reduction in gust frequency with increase in aircraft size, did not indicate that increased size alone would have a detrimental effect on the fatigue life.

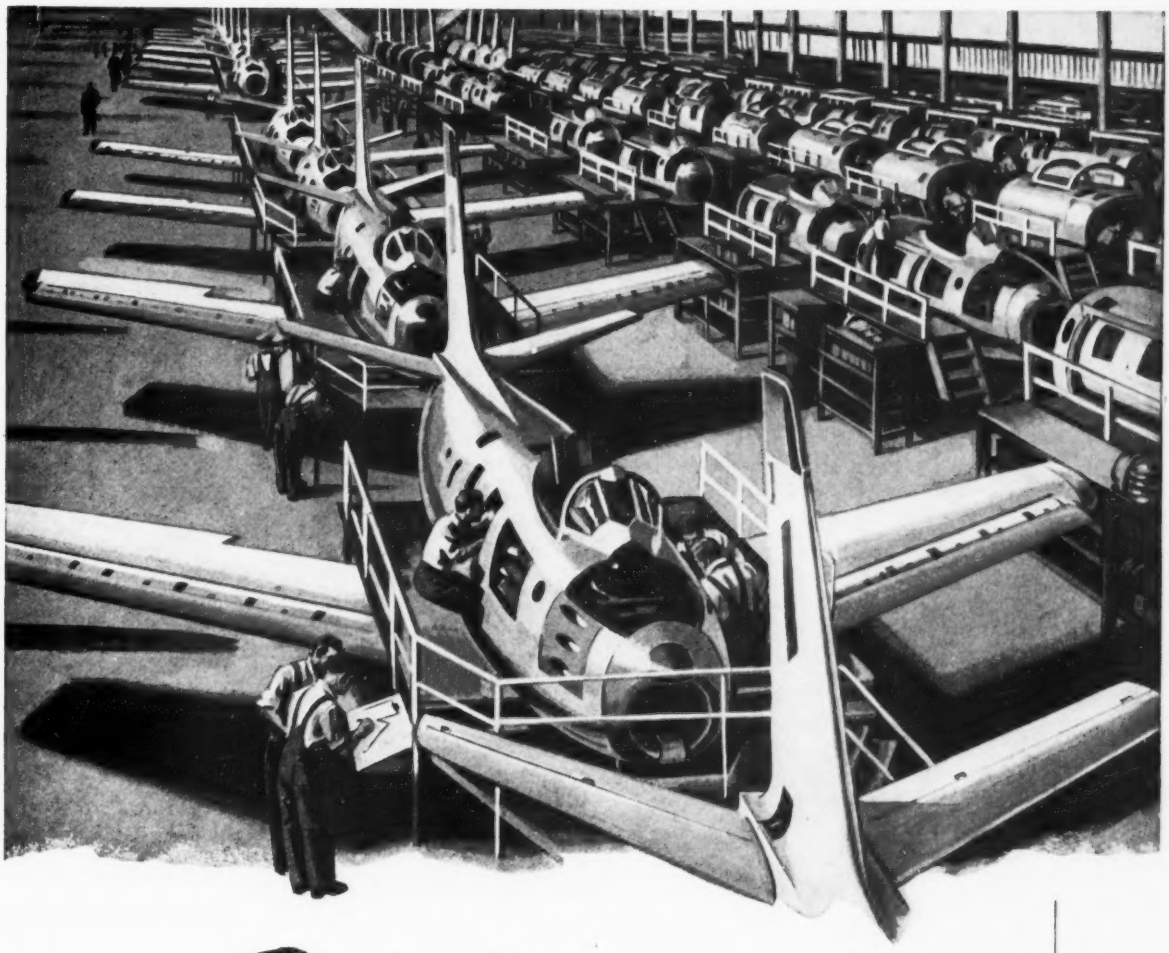
The increased ratio of useful load to gross weight, attributed to increased structural efficiency brought about by improvements in structural design and the use of new materials of increased strength, had sometimes been cited as a related factor to reduced fatigue-life.

A detailed examination showed, however, that the tendency for the primary tension material to have shorter fatigue life was in fact due to the improvement in structural efficiency obtained by the use of materials of increasing static strength-weight ratio (and through more effective structural geometry), and the correspondingly increased design stresses.

The variation of clear-air turbulence with altitude indicated that substantial reduction of repeated gust loading of jet transports because of their high cruising altitudes should not be expected.

Even if the repeated loads were known, Mr. Rhode continued, analytic prediction of the fatigue life of an aircraft wing was not possible at present. Extension of the fatigue lift through attention to detail design did not guarantee that fatigue failure would not occur during the useful life, nor that it would be non-hazardous if it did occur.

Thus proposals for fatigue-warning devices had been made. Such devices were of little value unless their indications were correlated with the indications of full-scale fatigue tests, either of the complete structure or of large parts of it. The effect of gust alleviators on the repeated loads should be carefully evaluated before using such devices; they should not be used to reduce design loads and structural weight, because basic structural integrity should not be made to depend on the reliability



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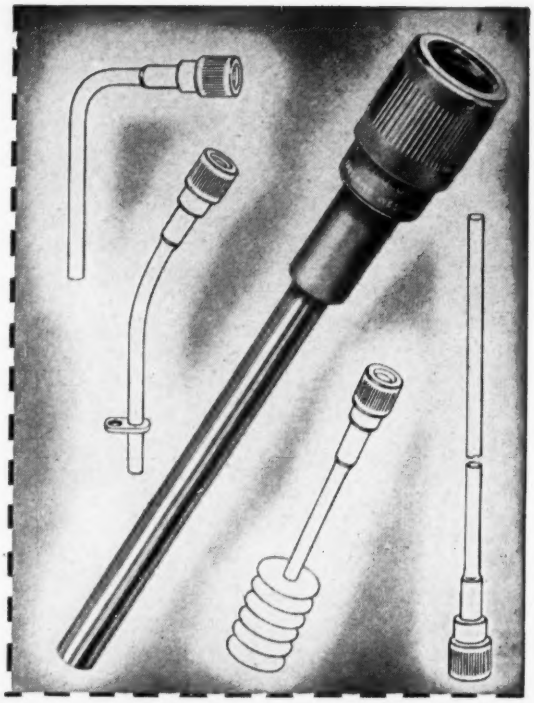

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THE ANGLO-AMERICAN CONFERENCE . . .

of mechanical or electrical systems.

Finally, Mr. Rhode discussed the extent of fatigue cracking and loss in strength in relation to crack detectability and structural redundancy. Redundancy, he argued, did not necessarily provide safety, but structural arrangements having intrinsic safety by virtue of detectable appearance of cracks before serious loss in strength occurred, were possible.

Discussion.—MR. WALTER TYE (A.R.B.) was the opening speaker in the general discussion which followed the lecture. He outlined the experience of the Air Registration Board with fatigue problems, stating that the Board possessed statistics for many different aircraft types and routes. DR. T. P. WRIGHT (I.A.S.) referred to the effect of publicity concerning fatigue on the morale of the air-travelling public, and to gust alleviation which was a good thing if aimed at the fatigue problem.

MR. R. H. SANDIFER (Handley Page) enquired whether gust frequencies differed between night and daytime values. The mixing of different materials in redundant structures should be avoided, he thought. The arguments for the use of redundant structures and more concentrated structures were compared by DR. P. B. WALKER (R.A.E.) with, respectively, falling downstairs and falling off a cliff. The choice was obvious, yet he did not really wish to fall downstairs—neither did he wish to fly in a cracked aeroplane.

DR. H. F. WINNY (Fairey Aviation) asked whether novel design features such as powered controls had influenced fatigue properties. The variation in the number of gusts experienced with change of height was greater than the lecturer indicated, claimed MR. J. TAYLOR (R.A.E.), quoting his unit's records, and there seemed little advantage from this point of view in flying higher than 20,000ft. Airline operators measured their aircraft's lives in years, submitted MR. J. F. M. ORAM (Bristols), and higher block speeds meant that a greater number of gusts would be experienced in, say, a ten-year life.

ANGLO-AMERICAN ACCORD

AT THE DORCHESTER: The dinner and dance which closed the Conference was a particularly enjoyable social occasion, and it also gave our artist the opportunity of selecting, as his subjects, 15 delegates widely known and respected on both sides of the Atlantic.

THE ANGLO-AMERICAN CONFERENCE . . .

THE AERODYNAMICS OF COMPRESSOR-BLADE VIBRATION

By H. PEARSON

(Chief research engineer, Rolls-Royce, Ltd.)

FATIGUE failure, said the lecturer, had always occurred in gas turbines. They were bad enough in centrifugal units but, with an axial, failure of one blade might wreck the engine.

The manufacture of single-shaft compressors of pressure-ratios greater than about 5:1 had increased the incidence of blade fatigue failure. Since the "off-design" performance of such units was fairly critical, the front rows tending to run stalled while the rear stages choked, it had been inferred that stalled flutter was playing a large part in such failures.

A great part of Mr. Pearson's paper was not necessarily applicable to modes other than that of fundamental flexure. In this mode, straightforward expressions could be written down for the energy removed by the airstream from a vibrating blade per unit length per second. The aerodynamic damping was the same whether the airflow was steady or pulsating, so that damping and excitation could take place simultaneously. As an example, a compressor blade tip of 2in chord in an airstream of 600ft/sec could be made to vibrate with a tip amplitude of 0.1in and a frequency of 400 c.p.s.; in this case, the energy removed per second per inch length would be 12 ft lb. If aerodynamic damping did not exist and this energy had to be absorbed entirely by internal damping, all the energy would appear as heat sufficient to heat the blade to nearly 300 deg C in still air, or 10 deg C above ambient in the high-velocity stream of the compressor.

Aerodynamic instability was next covered and, since with almost every blade flexural vibration introduced torsional oscillations, classical flutter was the first possibility of blade excitation. For any given arrangement there was a critical air speed at which self-induced oscillations began. Calculations on axial compressors showed that, because of the high blade frequencies, classical flutter could not occur until very large air speeds were attained. No cases of classical (coupled flexural-torsional) flutter had ever been reported for compressor blades.

Most axial-compressor failures were ascribed to the stalling of one or more stages. Tests on a cascade of blades showed that, with most blades, flutter was set up at the stall and was so violent that rapid failure occurred.

A particular case of aerodynamic excitation was the rotating stall in which the blade ran through wakes. The resulting vibration could then be assessed from the quality of aerodynamic excitation and damping, other damping being negligible by comparison. On the other hand, wakes should die out rapidly in a compressor and should rarely extend through more than two stages of blading. The lecturer closed his paper by pointing out the necessity of carrying out more test work in connection with stalled flutter to investigate the boundaries of flutter when blade stiffness and damping were varied.

MR. F. M. OWNER (D. H. Engine Company) was disturbed about the implications of the very high air densities in compressors during supersonic flight. Mechanical damping would therefore represent an even smaller proportion of the total. In reply, Mr. Pearson supported the questioner in his plea for really large-scale engine test tunnels capable of simulating supersonic flight conditions. On the other hand, damping should keep pace with excitation irrespective of the air density.

MR. A. D. S. CARTER (N.G.T.E.) said that he had found flutter at the highest blade incidences tested, and concluded that there must be some form of aerodynamic hysteresis. It was agreed that the whole theory depended upon the aerodynamic excitation being low. Experiments with plaster between the blade roots indicated that very heavy mechanical damping would be needed to overcome all flutter; it was, in effect, a high-Mach shock stall. Replying, the lecturer said that recent tests at very reduced flows showed stresses rising again at high incidences, but this condition was difficult to obtain on a test rig.

MR. H. TEMPLETON (R.A.E.) compared blade flutter with the behaviour of aircraft wings. He believed that there was a structural similarity, the main differences being on the aerodynamic side, especially in estimating the forces on the blade. With an aircraft wing in flutter the flow was rectilinear, and vortices shed travelled in straight lines, in complete contrast to the behaviour on any type of rotor. Mr. Templeton wondered whether, since compressor theory broadly relied on experiments, in which the specimens were small and measurements difficult, it would not be advantageous to undertake testing on dynamically similar compressor models larger than full-size in order to get at the root of the matter. Mr. Pearson regretted that the air supply required prohibited the use of such models, if the Mach number were to be kept representative. Again, the aircraft engineer was less interested in stalled flutter, whereas the stalled state was of vital interest to the designer of modern axial compressors.

DR. J. WILLIAMS (N.P.L.) suggested that the frequency parameter was a fair indication of the onset of flutter. Certainly there was strong vortex shedding if the rate of change of blade life coefficient with angle were negative, and this must push the blades pretty hard. The lecturer replied that the use of data on isolated wings were for the unstalled state, therefore the frequency parameter could only reduce flutter by half and was probably not a major variable. It was hoped by new blade design to lift the critical aspect ratio to at least three, but no correlation had been found in testing with the frequency parameter.

MR. S. B. BAILY (D.S.I.R.) pointed out that although the lecturer had confined his remarks to fundamental flexural modes, higher modes were often more important in engines like the Proteus where resonance frequency between cyclic variation in total-head pressure from the separated intake webs and the secondary modes of blade vibration could be important. Another factor was the variation in thickness between blades from the same die.

MR. G. M. LEWIS (Bristol) surprised the lecturer by describing cascade tests which were now being undertaken on aerodynamic damping in a model set of blades of a compressor. The results did not show very good agreement with simple formulæ, and the blades had been known to go into self-excited torsion flutter, whereupon they broke within two minutes. Below Mach 0.6 or thereabouts, pure flexure was clearly of over-riding importance. It was worth studying the flow over blade tips.

MR. L. H. G. STERNE (R.A.E.) queried the change in damping owing to the movement of shock-waves through the variable gap between blades vibrating in anti-phase. Mr. Pearson said that choking flutter did not usually occur in a compressor, except at the roots, where it could have little effect on blade distortion.

MR. F. B. GREATREX (Rolls-Royce) wondered whether the flow variation from the mean over the total area at entry to the compressor might not excite flutter without the need for resonance. Also aerodynamic excitation could introduce stalled flutter at the tip of the lift-curve slope. The lecturer replied that, with resonance absent, serious flutter was not met. The effect of variations over the intake were of minor importance, and it was remarkable that, with a combined inlet wake and a stalled state (no damping and wake excitation) the stress on the blades went down.

AIRCRAFT DE-ICING BY THERMAL METHODS

By J. L. ORR, D. FRASER and J. H. MILSUM

(Low-Temperature Laboratory, National Aeronautical Establishment of Canada)

THE paper was read by MR. J. L. ORR, director of the N.A.E. Low-Temperature Laboratory. He stated that icing conditions with a horizontal extent as high as 1,000 miles had been recorded, but that usually the more severe the icing was the shorter its extent. Furthermore, though icing could be experienced at all altitudes up to 40,000ft, its maximum observed depth was of the order of 10,000ft. About priority in ice protection, he stated that the critical section of an aircraft was its power plant, and that this must therefore receive the highest de-icing priority. Axial-flow jet engines were the most critical in this requirement, since ice could cause immediate and complete failure of the compressor blades.

Discussing ice formation, Mr. Orr explained that the shape of ice accretions was determined by the freezing fraction, while the chordwise extent of icing depended on the impingement pattern of droplets. Three shapes of ice accretion were generally encountered, mushroom, knife-edge, and spearhead. Under many conditions, droplets did not freeze completely upon impingement, and "runback" occurred beyond the impingement zone. Where ice was allowed to form on a surface, further accretion was hindered by the shielding effect of the original formation. Mr. Orr then gave the speed beyond which normal kinetic heating would prevent ice formation as 0.6 Mach.

Wings, unlike airscrews, did not provide any shedding forces apart from drag and lift. Since ice formed as a mushroom over the leading edge was stable even when not adhering to the skin itself, it had to be split at the leading edge by a continuously heated parting strip. Similar dividing strips had to be provided in a chordwise direction to break up layers of ice for shedding. A double system was therefore required for the wing, consisting of three elements, the leading edge parting strip, the dividing strips and the shedding zones.

Hot gas as opposed to electrical heating had its advantages both in sources of supply of hot air in jet aircraft and because the wing skin was left untouched. The usefulness of hot gas de-icing, however, was, in his opinion, practically cancelled out because of the very large quantities of gas required for such systems.

The problem of helicopter rotor blade de-icing, the speaker continued, showed that the unbalance due to ice accretion on rotors was more critical because of the relatively greater areas and radii involved. Change of blade angle of attack also led to a wider icing zone. Unlike the normal airscrew, the extreme tip of a rotor must be protected, and greater heating would be required at the tip than at the centre. It was, on the other hand, unnecessary to protect the blades inboard of the point of flow reversal at cruising conditions. It was suggested that de-icing coverage should extend to 30 per cent chord on the suction face of the blade and to 40 per cent on the pressure face.

Mr. Orr then showed a diagram of the comparative amounts of heat required for a given wing for either de-icing, "wet" anti-icing or "dry" anti-icing, and showed that the thermal energy requirement for an electrical de-icing system might range from $\frac{1}{4}$ to 1/80 of that for a hot gas anti-icing system.

Discussion.—Various questions were raised, particularly in regard to icing protection for aircraft at present under design or development. Slides were shown demonstrating the magnitude of the problem of anti-icing protection for the huge radomes of the Lockheed Super-Constellation radar early warning aircraft. MR. DAVID RENDEL (R.A.E.) stated that although in theory electro-thermal de-icing was the most economical, in practice considerable problems were encountered on large, high-altitude aircraft. Among these were the thermal inertia of a large wing, and the mechanical difficulty of protecting leading edge flaps against icing. For such extensive surfaces, inordinate generating facilities would be required, and it would appear more economical to use compressor gases, these being already used for cabin heating and sundry other duties. The problem of de-icing leading edge flaps arose with the Victor. In connection with this aircraft, he also pointed out that really high icing would only occur for a few seconds at a time on such a high speed aircraft.

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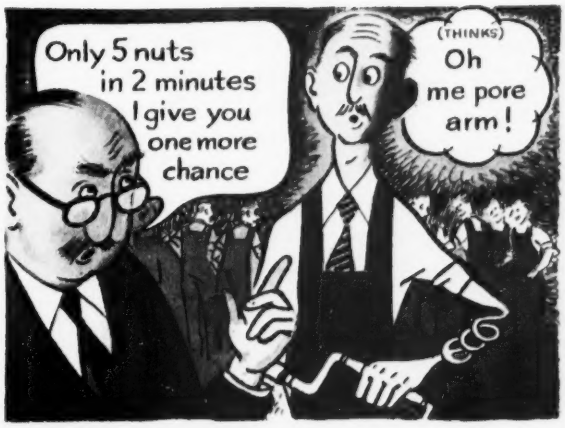

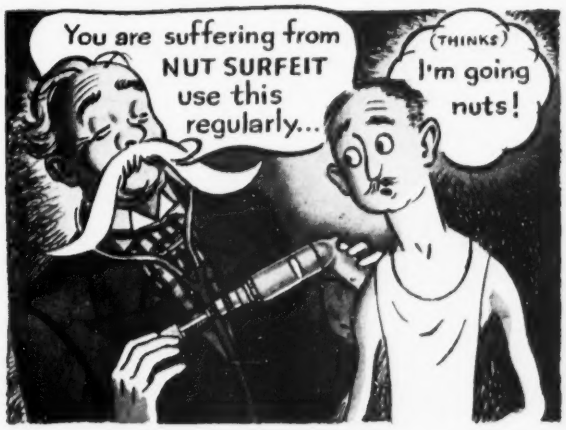

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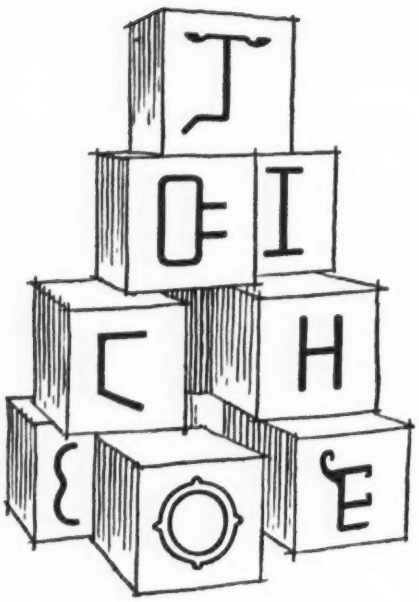

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PREREQUISITES FOR PRODUCTION

By R. A. NEALE

Vice-President Manufacturing, Canadair, Ltd.

MR. NEALE began by outlining the work being performed by his company, Canadair Ltd., in the construction of F-86 Sabres and T-33 and T-36 training aircraft, and went on to deal with the problems of production under the respective headings of plans, plant, policy and people.

The first of the four in natural sequence were plans, which were subject to change and therefore must be as flexible as possible. The development and manufacture of an aircraft involved extensive planning which must be laid down in a detailed and orderly fashion, particularly when substantial quantities were contemplated. This was more than a general overall plan, and it included firstly the determination of the objective, secondly, the specifying of how, when and by whom the plan was to be executed, and thirdly, the means of appraisal by management. The plan did not emerge as a fixed, static plan from its inception, but rather evolved through a series of stages, each of which contributed to its detail and scope.

The correlation between the production build-up and the logistics curve had been demonstrated in a College of Aeronautics report by Stanley, based on an analysis of Second World War aircraft production programmes of Britain, the U.S.A. and Germany. It appeared that there was no connection between the rate of build-up and the size of either the aircraft or the production programme, and so it seemed that the skill and efficiency of the organization and the design of the aircraft were the determining factors.

The second aspect was that of plant. The planning of plant facilities was a continuing process and was carried out in a less precise manner than the processing and scheduling just described, but within the same overall framework. A broad and general estimate of space required was made even before the contract was entered into, and this was refined by stages until line positions and the number of jigs were determined. Machine tools, test equipment and other facilities were planned in a similar manner.

Within the lines of broad Government and Corporate policy, that by which the manufacturing effort was conducted had been made in meetings between the heads of various departments of the manufacturing division, together with the engineering department. Each department head had in turn held weekly meetings with his subordinates, and this continued down to the lowest level of supervision. There was relatively little difficulty in establishing general policies or in altering them to suit changing conditions.

Sound human relations implied teamwork, and to obtain this, the people involved must be dealt with as people and not as numbers or lines in statistical reports, graphs and trends. They must be guided by the best leadership obtainable, and developed under the most enlightened "work climate" which fully appreciates the importance, dignity and uniqueness of the individual. The value of the top priority given by Canadair management to the subject of human relations was decisively shown in its strike-free history, and was felt in large measure to have resulted in the company's excellent production accomplishments.

Discussion on the lecture was opened by CAPT. G. F. BEARDSLEY, U.S.N., who emphasized that an aircraft was "time-sensitive", and thus a basic pre-requisite was to have a design that would be competitive when eventually delivered in a usable condition. Too often, he continued, schedules were compressed unrealistically in order to obtain business by giving an early delivery date, while the customers, too, were at fault in demanding too many changes in design.

MR. W. S. HOLLYHOCK (Hawker Aircraft) pointed out that in the elapsed-time chart, an overlap between the engineering and production periods was usual. Planning by the customer, as well as the manufacturer, was essential, stated DR. T. P. WRIGHT (I.A.S.), for chaos could be caused by the sudden cancellation, or even increase, of a production order. He went on to suggest that a difference in aircraft size would influence the logistic curve chosen, a point that was confirmed by the meeting's capable chairman, MR. C. E. ROBERTS of the Boeing Airplane Company.

The danger of a little learning-curve knowledge to the workers on the shop floor was ironically stressed by MR. BEVERLEY SHENSTONE (B.E.A.), the next speaker, who enquired concerning non-symmetrical acceleration curves. MR. H. B. HOWARD (M.o.S.) indicated a pertinent fact which applied in this country, but not in the U.S.A.—the learning curve did not begin to operate until the piecework rates were fixed, usually after the construction of the first few aircraft.

The need for an intake of university graduates into the production side of industry was stressed next, by MR. H. G. CONWAY (British Messier). In the subsequent discussion on the achievement of production targets in this country and America, MR. J. C. KING and MR. J. C. K. SHIPP, both of the English Electric Company, gave details of their company's experience.

THE INTRODUCTION OF THE COMET INTO SERVICE

By A. C. CAMPBELL ORDE

(Operations Development Director, B.O.A.C.)

MR. CAMPBELL ORDE'S frank and very informative lecture left no doubt that, in his own words, "the general performance of the Comet I in its first year can be considered highly promising . . . the inherent advantages of this type of aircraft for passenger service have been well demonstrated." He presented a table (page 482) showing from the B.O.A.C. viewpoint some crucial steps in the introduction of the world's first jet airliner service.

It was recommended that the simple jet aircraft envisaged in 1944 should be followed up at the earliest possible date by one with airscrew or ducted-fan power-units, which then appeared the next logical step in the civil development programme. This second generation of gas turbine aircraft, it was felt, should produce a design capable of North Atlantic operations. The makers' early performance evaluations of the Comet I held out hope that the North Atlantic requirement might be met, but it was not true that there had ever been such a requirement by B.O.A.C.

An important decision made—on the recommendation of the manufacturers—in October 1946 was to reduce the wing sweep and make other design changes (the original 40-deg-sweep project is illustrated on page 482 of this issue), and the production aircraft proved to be more matched to the engine performance available. Another important change was the adoption, in November 1948, of a four-wheel bogie undercarriage, reducing the relatively high runway bearing load of the original design, and hazard in the event of tyre failure.

With the exception of performance near the ground and the general influence of lower drag, the Comet was basically easier to handle than an equivalent piston-engined aircraft. Training courses for conversion to the Comet occupied 19 weeks compared with 18 weeks for the Argonaut and 14 weeks for the Stratocruiser (for which the flight simulator was available). The Redifon flight simulator for the later Comets would reduce flying time and improve the quality of training.

A graph showing cumulative revenue miles per aircraft by the Comet I and Argonaut, over their first 10 months of service, proved that the jet aircraft had done as well as the other, type for type—flying 300,000 miles compared with less than 200,000 for the Argonaut. In terms of capacity-ton-miles per hour and overall load factors the Comets had given better results than any other B.O.A.C. aircraft. Better punctuality (on the basis of hours lost per thousand revenue miles) was achieved with the Comet at practically all times during the first nine months of its operation than with the Stratocruiser and Argonaut over comparable periods. The general trend of failures was normal but the overall result, particularly with the power-plant, had to be regarded as distinctly encouraging for such radically new equipment. A comparison of block times achieved with the Comet and Argonaut on the Rome-Cairo sector in the summer of 1952 showed up well the inherent advantages of the faster aircraft. The Comet's block time on 50 per cent of occasions was 3¼ hr or less; the Argonaut's on 50 per cent of occasions was 6¼ hr or less. Variation of block speed with wind was much greater for the slower aircraft. On a typical sector the faster aircraft could not take full advantage of its higher performance, and its block speed was 80 per cent of normal cruise speed, whereas the Argonaut achieved a ratio of 90 per cent.

Some interesting observations were made of relative manoeuvring times at London Airport of Comets and Hermes IVs. The time from chocks away to airborne was anything from three to eight minutes less for the Comet than for the Hermes; runway occupancy on arrival was about equal at 110 secs. A combination of one jet aircraft landing and one taking off was allocated a minimum of 210 sec compared with 130 sec for a similar combination of piston-engined types.

The considerably reduced flight times of jet aircraft threw fresh emphasis on navigation aids, communications and operational ground organization: and the more concentrated workload on crews and control personnel required radically new methods. Another Comet-Argonaut comparison showed that if standard procedures were applied to the Comet as for other types of aircraft, both the crew and associated ground staffs would be called upon to perform almost twice as much work.

Comet operation was begun on the basis of a normal 60-min transit stop. At the outset, the aircraft was designed to make the shortest possible stop and the design objective given to de Havilland was for refuelling from empty to full tanks in 25 min. On B.O.A.C. routes it was improbable that refuelling by itself would be the limiting function. The 40-min transit stop introduced in April 1953 brought about a marked improvement. Some sacrifice of punctuality along the route in exchange for minimum elapsed time between terminals seemed to be well justified with faster aircraft.

Discussing aircraft utilization, the author observed that operating and commercial restrictions, many of which were outside airline control, meant that the higher utilizations in airline condition were likely to be achieved by the slower types of aircraft. A minimum utilization had to be achieved by any type before it reached its optimum effectiveness on a given service. Beyond this, further increases produced diminishing gains. Changes of utilization with a turbine aircraft would have proportionately less effect on total operating cost than with the slower machine.

In the discussion Mr. W. Littlewood (American Air Lines) affirmed that there was room for both turboprops and turbojets each in its respective sphere. Jets could be quite as reliable as piston engines, said Dr. E. S. Moult (de Havilland), adding that there was no reason why Ghost overhaul hours on Comets should not increase from 600, with second running at 750, to 1,000. Mr. C. Dykes praised Mr. Campbell Orde's lecture, which had analysed the Comet project as a whole.

Replying to questions, the author expressed the hope that reverse thrust could be avoided. It would be "taking out what we had put in." Utilization was subject to the inherent limitations of the 24-hour day and B.O.A.C. operations would show up better if the Comet were used on a high-efficiency route only. Regarding noise, there was not much trouble on the eastern Comet routes but there was concern about the future effect at L.A.P. of higher frequencies and more powerful engines.

THE ANGLO-AMERICAN CONFERENCE . . .

RECENT ADVANCES IN BOUNDARY LAYER AND CIRCULATION CONTROL

By C. D. PERKINS and D. C. HAZEN

(Professor and Ass. Professor, Dept. of Aeronautical Engineering, Princeton University)

THE paper was read by Mr. Hazen. He began by discussing the various types of system possible, and illustrated eight of these with excellent flow photographs from a smoke tunnel. (Boundary layer and circulation control can be used to reduce flow separation and thereby increase lift; to control transition of the boundary layer from laminar to turbulent, so reducing drag; or to increase the aerofoil circulation directly, thereby increasing lift at a given angle of attack.)

Drag reduction by controlling boundary layer transition had been studied by Mississippi State College, under Dr. Raspet, and a description of the sailplane used and results obtained was given. The loci of transition between the laminar and turbulent boundary layers was determined with a stethoscope, the former giving a hiss and the latter a roar. Eventually, the work showed that even very low suction could reduce total drag—by 54 per cent, compared with a smooth, impervious profile—provided the porosity distribution and suction power *just* maintained laminar flow without reducing boundary-layer thickness. Artificial thickening of the layer near the leading edge might be required at high speed.

The use of a trailing-edge suction slot to control circulation had been studied by Regenscheit, whose work was continued by various American groups. The lecturer gave a theoretical analysis of trailing-edge suction lift effect and included a wide range of results of lift, drag and pitching moment investigations on ten trailing-edge configurations. He concluded that, taken simply as a flow singularity added to a profile, trailing-edge suction offered possibilities in the field of aerodynamic control for fixed-wing aircraft, or as an alternative to cyclic-pitch control on helicopters. When combined with a split flap it promised to be an efficient high-lift device.

As one of the groups involved in trailing-edge suction experiments, Princeton University had been led into what the paper described as "one of the most interesting and potentially important developments in subsonic aerodynamics"—the determination of a new means for creating and stabilizing a vortex at a desired location. Wind-tunnel turbulence was responsible for this, and a diffuser was eventually tested with small expansion angle, leading into a larger chamber *via* a sudden jump in cross-section, there being large cusps at the tunnel walls.

It was found that these cusps housed two trapped vortices, at right angles to each other, the resulting complex flow within the cusps being free from turbulence. Further experiments with cusps utilizing automatic vortex formation involved aerofoils; the lecturer went on to describe their behaviour under various conditions with increasing suction. The most notable feature was the powerful effect of the vortex on the downwash. In one form of profile/cusp it was possible to obtain adherence at an angle of attack of 120 deg.

Princeton was continuing this work, and the lecturer pointed out that—particularly as 1954 marked the 50th anniversary of Prandtl's original concept of flow control—the time had arrived for the construction of a practical, powered aircraft designed around a flow-control system.

Opening the discussion, DR. W. F. HILTON (Armstrong Whitworth) dealt at some length with the behaviour of trapped vortices, and pointed out that their presence should reduce the length and cost of a tunnel diffuser section. PROF. SIR MELVILLE JONES favoured perforated suction surfaces, for he felt the former could more readily be kept clean. He urged intensive study of all types of intered or perforated surfaces. PROF. A. D. YOUNG (College of Aeronautics) underlined the importance of smooth surfaces: if the Reynolds number of an irregularity exceeded 50 the flow would break down: this meant that the profile had to be correct within 0.001in on a 10ft chord for laminar flow, or within 0.0003in. with suction. MR. G. S. SCHAIRER (Boeing) was concerned, as a practical manufacturer, with the cost of such systems; he also queried the behaviour of the boundary layer near shock waves.

STRUCTURAL ADHESIVES FOR METAL AIRCRAFT

By Dr. N. A. DE BRUYNE

(Managing director, Aero Research, Ltd.)

CONDENSING the salient points of his written paper into a 30-minute talk, Dr. de Bruyne began by referring to the structure weights of present-day aircraft, quoted previously by Mr. Hibbard to be in some cases 22 per cent of the all-up weight. This was a very low figure compared with those of ten years ago, Dr. de Bruyne continued, and yet a further reduction in structure weight was necessary. One attempted method has been to increase the design stresses, but as this was accompanied by a steady fall in fatigue life, other ways of reducing weight were required.

Adhesives were one such way. Apart from the saving in weight, the advantages of adhesives included a smooth external finish, increase in fatigue life, simplification of design, and reduction of production costs and times. Giving examples of the use of adhesives in existing aircraft, the speaker showed a section of the Britannia leading edge structure, with an inner corrugated skin Redux-bonded to the smooth, thin outer skin which was thickened at the points of attachment. A more ambitious use was found in an all-metal spar produced by the Fokker Company; on this, the Redux bonding was done in a flat hydraulic press, and the flanges formed in a rubber die press.

In the Comet, there was much Redux bonding; for example, extruded stringers were Redux-bonded to the fuselage skin. The pressure bulkheads of the Comet and Britannia, and the trailing-edge reinforcement of the Convair B-36, were also indicated by the lecturer as examples of Redux use.

Dr. de Bruyne then continued to the second part of his lecture, dealing with what existing adhesives could do, given intelligent design, in future aircraft. The wrinkling experienced when stringers were used could be overcome by a form of continuous reinforcement, for instance, sandwich construction, such as the balsa-cored sandwich used by Chance Vought. Of the synthetically expanded cores, the "honeycomb" type was very successful, although solid forms were convenient to use.

After giving details of tests on the structural efficiency of Redux-bonded honeycomb panels, the lecturer stated "the economic significance of the increase in efficiency is remarkable." He concluded by showing films of British and American peel tests on honeycomb sandwiches.

In Dr. de Bruyne's written paper were given details also of methods of surface preparation, application of pressure and heat, inspection procedure, the effect of geometry on the strength of glued joints, fundamentals of adhesion, and detailed test results.

The general discussion on structural adhesives was opened by MR JOHN J. FOSTER (I.A.S.) who reported on his own experience which showed that honeycomb structures of ¼in cell size gave peel strength test results as high as 100 in lb. High-temperature adhesives were being developed, he continued, and adhesives and sandwich construction were being used for primary structures. DR. D. WILLIAMS (R.A.E.) traced the progress of work at Farnborough on sandwich construction, and mentioned the difficulty of discovering failures in a structure incorporating sandwich construction.

MR. F. TYSON (Handley Page) enquired whether Redux-bonding would be sufficiently strong for use with the stronger cores which were being developed. A form of bonding requiring neither test nor pressure was the ideal, he maintained. Work performed at Imperial College, London, on bonded structures was briefly described by DR. J. H. ARGYRIS, and among other subjects discussed were the relative merits of sandwich, integral machined and integral forged construction; the need for ribs in sandwich wing structures, the use of Redux in helicopter blade construction; and the use of sandwich construction for prototype aircraft.

THE CONTROL OF FLIGHT

By PRESTON R. BASSETT

(President, Sperry Gyroscope Corp.)

MR. BASSETT, in his paper, gave a summary of the development and application of instruments to the control of flight over the past 50 years. He divided his lecture into a discussion of what he termed as the "three layers" of instrument development. The first layer covered the introduction of instruments as an aid to the pilot, when the performance of his aircraft reached such a level that his own senses were no longer able accurately to interpret its performance in relation to the ground or the horizon.

During and immediately after the first world war, the inevitable step forward was tackled; the problem of completely blind flying had to be solved. With the introduction of gyroscopic instruments, regular passenger-carrying operations became a possibility, and parallel development during the years 1929-33 in passenger aircraft design made this a reality.

It was in Layer 2, also, that the autopilot was successfully introduced into service as a relief for the human pilot. Layer 3, Mr. Bassett stated, covered the period up to the present day in which the three elements of blind operation, the pilot, his instruments and the autopilot, were co-ordinated into a team. Regarding the essential factor in airline operation to be the success of the approach at the destination, he proceeded to enumerate the lines of development which had been and were being followed in solving the problem of instrument approach. By means of the flight director, or zero reader, the pilot could now make an accurate instrument approach down to the point at which he, better than any machine, could determine the success of the approach.

Discussion.—In the ensuing discussion, various suggestions were put forward for easing the pilot's problem in the final transition to visual landing. MR. IVOR BOWEN (M.o.S.) suggested a television picture projected on to the windscreen, but the main suggestions put forward were for a pilot-supervised autopilot approach designed to give the human pilot the ability to concentrate more wholeheartedly on the final visual take-over. MR. C. F. JOY (Handley Page) suggested the possibility of an aircraft designed to land itself without either autopilot or human aid. MR. A. C. CAMPBELL-ORDE (B.O.A.C.) struck nearest to the bone in suggesting that the vital factor in giving the pilot time for the visual take-over lay in reducing aircraft approach speeds. Mr. Bassett, in answering the discussion, stated that, so long as passengers were carried in aircraft, the human pilot would have to accompany them, although future lines of development indicated that he would have a supervisory rather than an executive function in aircraft management. However automatic flight became he would never become totally redundant, and he would always require a set of basic instruments with which to check the functioning of his automatic equipment. Future progress in instrumentation, he concluded, must lie in development of flight director-type systems and development of pictorial map position indicators.

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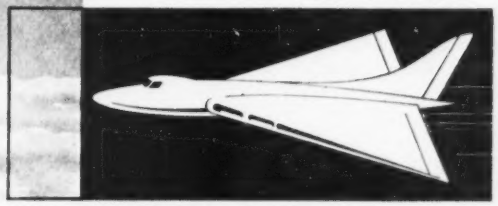

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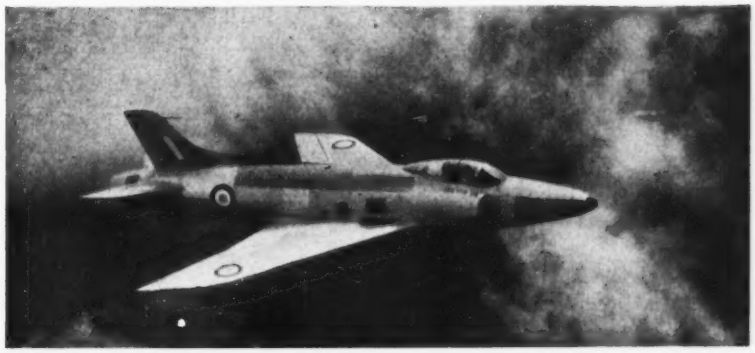

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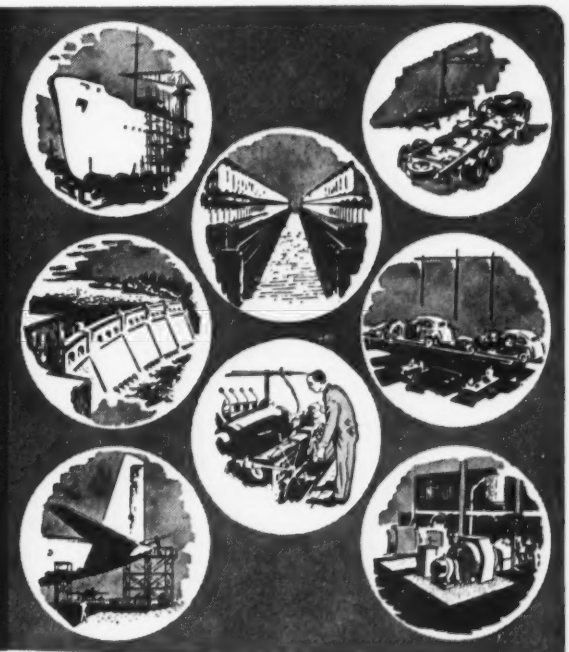

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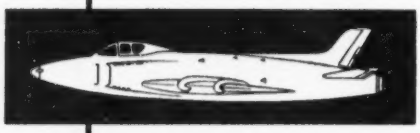

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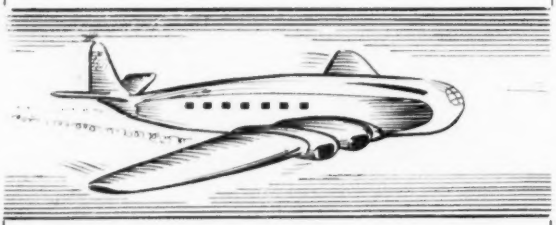

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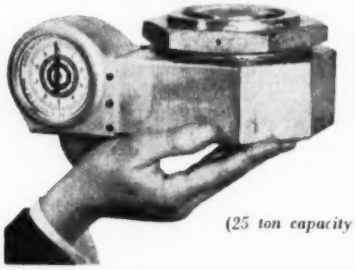

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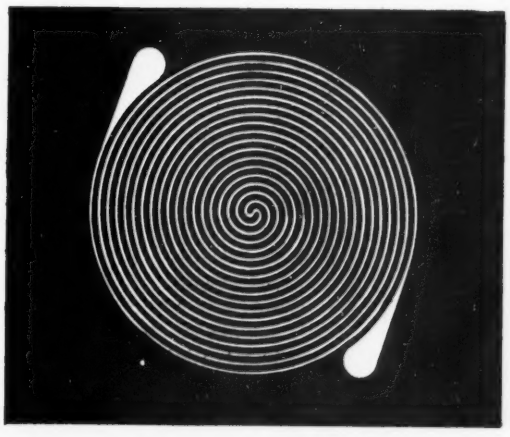

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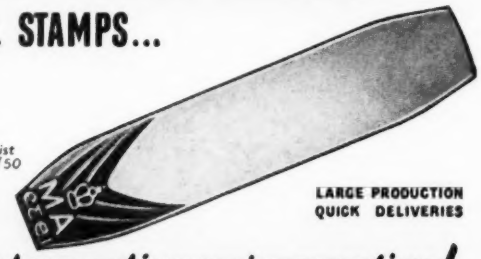

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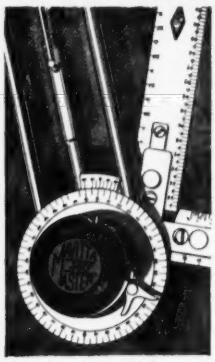

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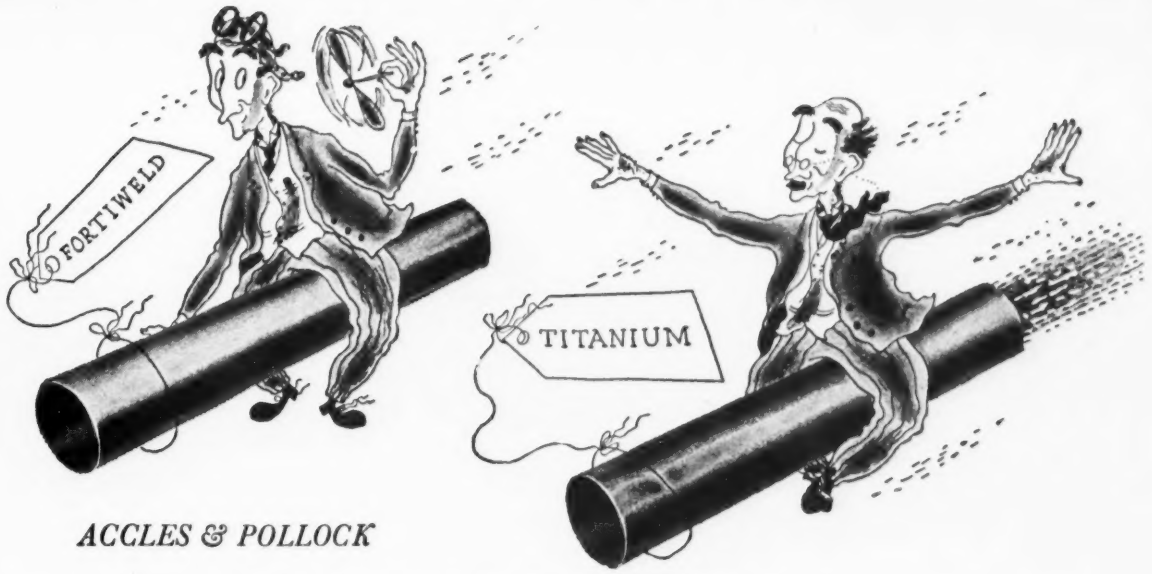

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PUBLIC ANNOUNCEMENTS

AIR TRANSPORT ADVISORY COUNCIL

THE Air Transport Advisory Council give notice that they have received the undermentioned applications to operate scheduled air services:—

From B.K.S. Aerocharter, Ltd., of 13a Old Burlington Street, London, W.1:—

Application No. 216. For a Seasonal Inclusive Tour service with Dakota aircraft for the carriage of passengers and supplementary freight between Newcastle and/or West Hartlepool and Isle of Wight (Bembridge) at a frequency of from one to three services weekly, from April to September for a period of seven years commencing April, 1954.

Application No. 217. For a Seasonal Inclusive Tour service with Dakota aircraft for the carriage of passengers and supplementary freight between Newcastle and/or West Hartlepool and Tarbes (for Lourdes) at a frequency of from one to five services weekly, from April to September for a period of seven years commencing April, 1954.

Application No. 34/1. For an increase in frequency commencing on May 1st, 1954, of up to 12 services weekly on their U.K. Internal service between West Hartlepool (Greatham) and London (Northolt) (Application No. 34), for the period of their current approval by the Minister of Transport and Civil Aviation which expires on December 31st, 1959.

Application No. 9/1. From Don Everall (Aviation) Ltd., of Elmdon Airport, Birmingham, for permission to operate an additional flight on their U.K. Internal service (Application No. 9) approved by the Minister of Transport and Civil Aviation for operation between Birmingham (Elmdon) and Jersey on Saturdays until December 31st, 1959, this additional flight to be on the route Nottingham-Leicester East-Birmingham-Jersey.

These applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on July 30th, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 9 Buckingham Gate, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, must reach them within the period allowed for the making of representations or objections. [1098

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SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through the local office of the Ministry of Labour and National Service, etc., if the applicant is a man aged 18-64 or a woman aged 18-59 inclusive, unless he or she or the employer is excepted from the provision of The Notification of Vacancies Order 1952.

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QUALIFICATIONS. Honours degree in physics or mathematics; experience in climatology, training of meteorological staff and forecasting is essential.

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SENIOR and intermediate design draughtsmen with good experience of aircraft or light structural or mechanical engineering, required for aircraft and armament project work.—Apply, by letter, to Portsmouth Aviation, Ltd., The Airport, Portsmouth. [0612

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COMMUNICATIONS giving experience and qualifications should be addressed to the Recorder, The College of Aeronautics, Cranfield, Bletchley, Bucks. Further particulars available. [1089

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ELECTRONIC wiremen required for work in prototype vibration equipment on helicopter and fixed-wing aircraft.—Applications, in writing, to Personnel Manager, Percival Aircraft, Ltd., The Airport, Luton, Beds., stating age, experience and salary required. [0600

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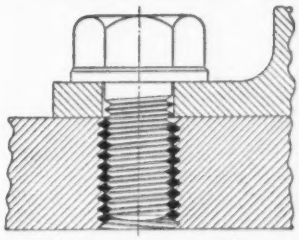

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H. M. HOBSON, Ltd., invite applications for positions in the drawing office as follows: designers, detail and modification draughtsmen, checkers, stressmen. The work is concerned with interesting projects connected with fuel metering equipment and hydraulic flying controls for aircraft.—Hobson Works, Fordhouses, Wolverhampton. [0420

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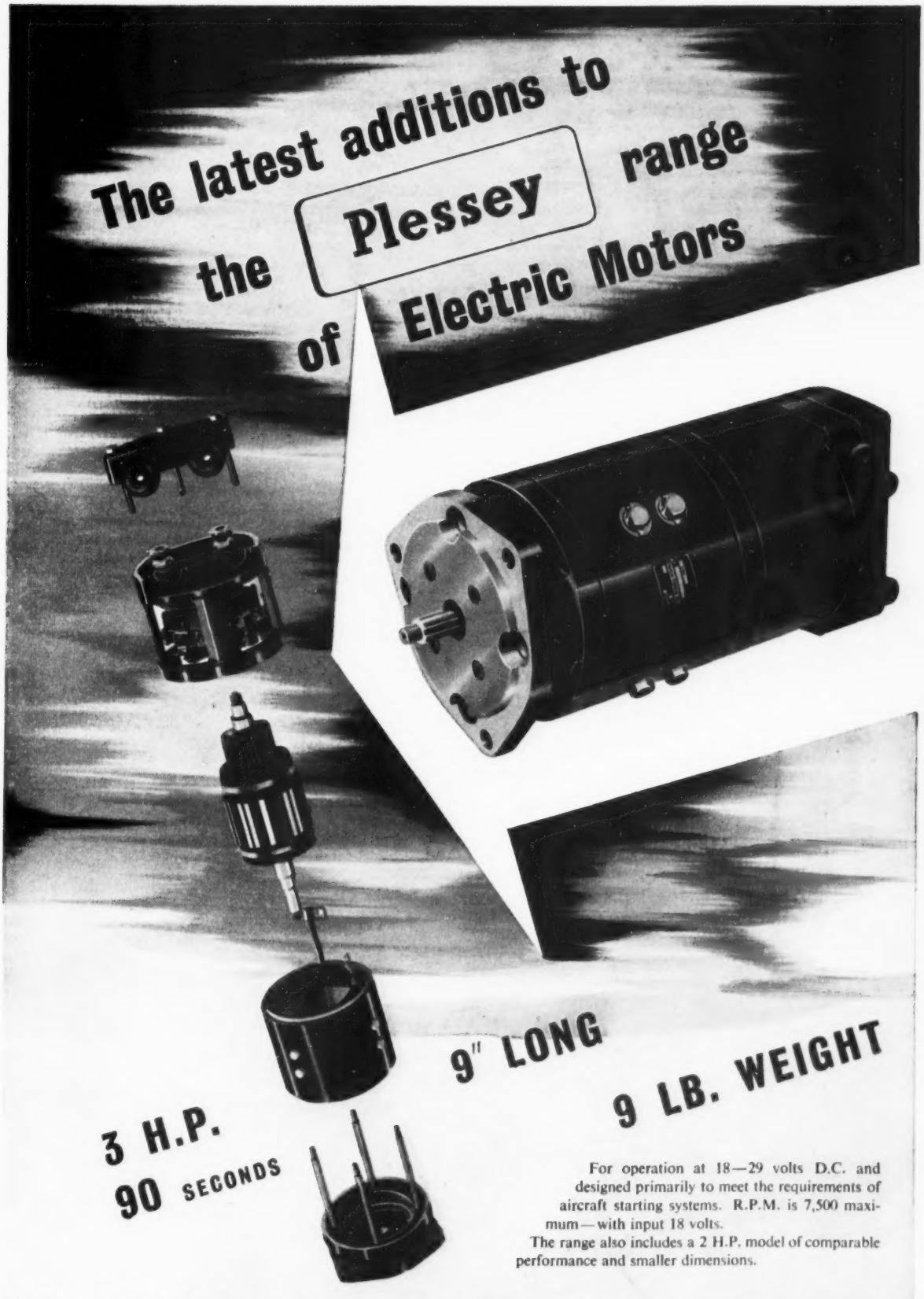
Printed in Great Britain for the Publishers, ILIFFE & SONS LTD., Dorset House, Stamford Street, London, S.E.1, by SUN PRINTERS LTD., London, and Watford Herts. *Flight* can be obtained abroad from the following: AUSTRALIA AND NEW ZEALAND: Gordon & Gotch, Ltd. INDIA: A. H. Wheeler & Co. CANADA: The Wm. Dawson Subscription Service, Ltd.; Gordon & Gotch, Ltd. SOUTH AFRICA: Central News Agency, Ltd.; Wm. Dawson & Sons (S.A.), Ltd. UNITED STATES: The International News Co. Entered as Second Class Matter at the New York, U.S.A., Post Office.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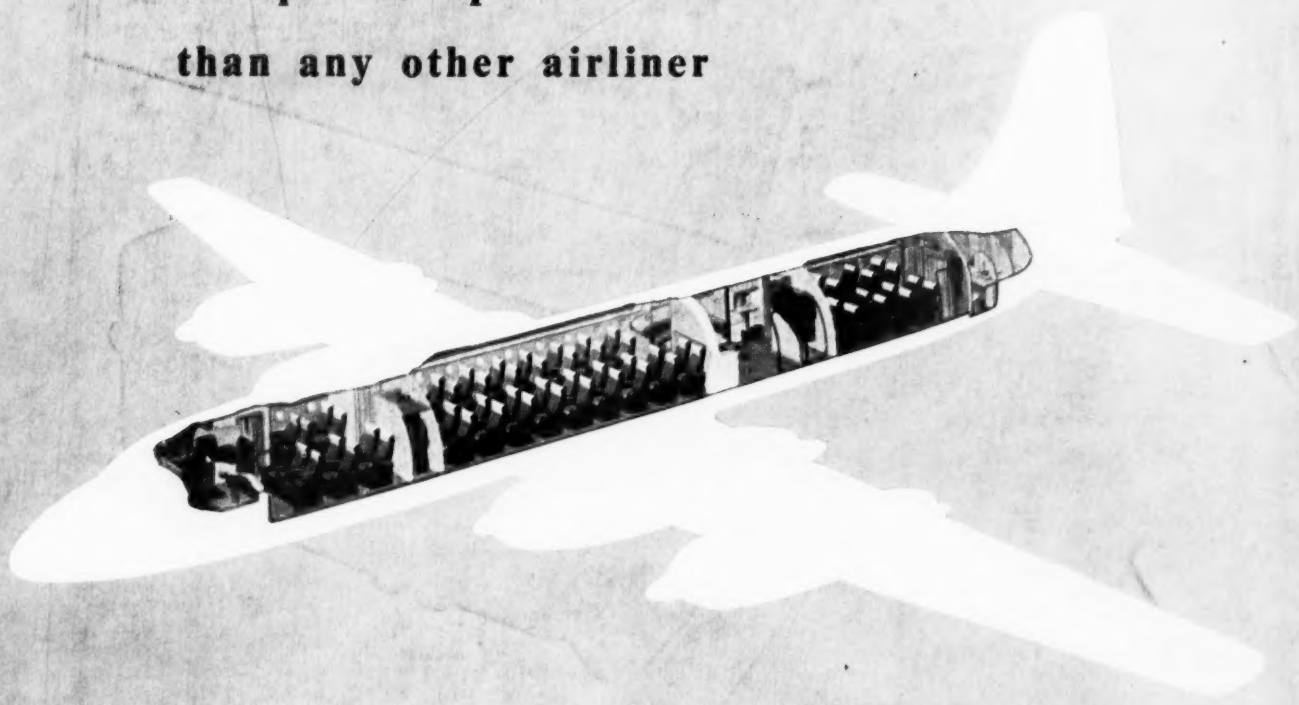

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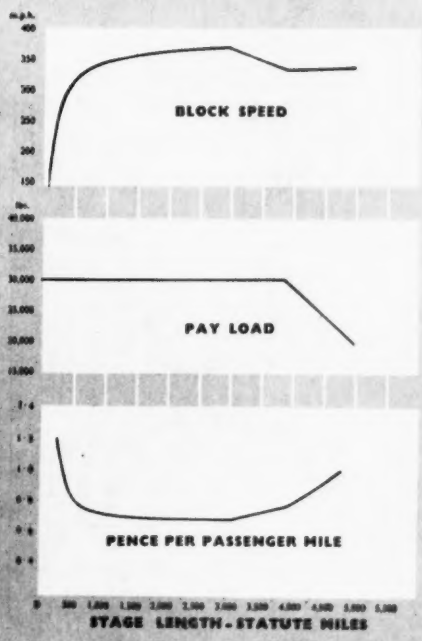

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